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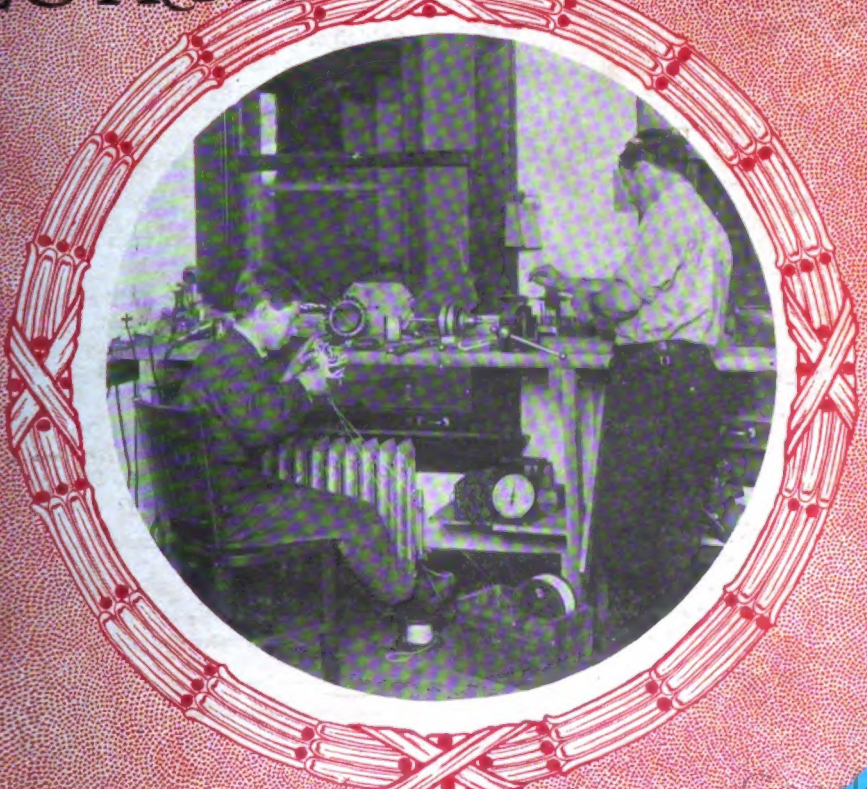

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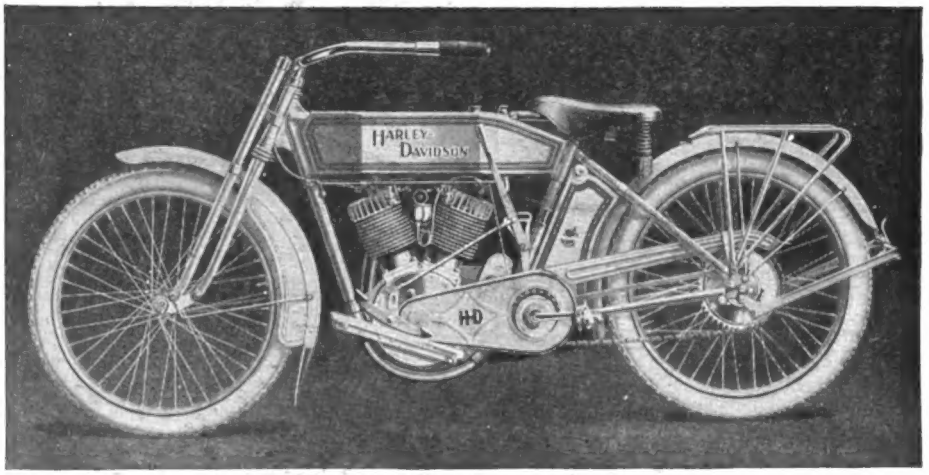

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The Step-Starter in case of an accidental stalling of the motor, does away with the necessity of getting off in the mud or holding up traffic while the rider finds a level place on which to lift or lurch the machine onto the stand in order that he may pedal the motor to start it. Instead, the rider sits in the saddle and gives either pedal a downward push—when the Step-Starter does its work and the motor again begins to throb.

It is the only Motorcycle with Double Clutch Control

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It is the only Motorcycle with a Ful-Floteing Seat

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G. H. BRINKLER, Food Expert.

During the past twenty years I have watched the effects on elderly people of eating vital, nerve-feeding foods (lean meat, poultry, game, fish, whites of eggs and curdled custard) with very little starchy or non-vital foods. In each case the result was increased activity in business or in the home. *The senses become more alert, the eyes strong and clear.*

Those eastern nations, peasants and poor people whose diet is largely of starchy, cereal foods are non-progressive. Leading nations and the ruling classes of both men and animals eat vital, digestible brain and nerve-nourishing foods.

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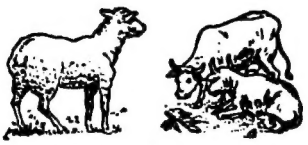
Professor Slonaker of Stanford University has proved by careful experiment that meat-eating rats live twice as long as vegetarian rats, do seven times as much work, grow twice as big and retain youth longer, *and he believes the same is true of humans.* He put rats in rotary cages with speedometers attached and found that in 25 months the meat-eating rats ran more than 5,000 miles while the "vegetarians" ran less than 500. These facts corroborate the results I am daily securing for my consultants.

Carnivora are active, alert and long-lived.



Herbivora are sluggish, stupid and short-lived.

How to Judge a Man by the Food He Eats

No one who eats chiefly a starch diet *can* be mentally active for long. Brain workers *must* eat plenty of lean tender meat, fresh vegetables and juicy fruits, or their alertness decreases and they become dull and sluggish. Science has proved that sour milk is *not* conducive to longevity in brain workers. My booklet tells you exactly what effects various foods exert—how to select your diet to suit your needs and occupation.

Foods Must be Rightly Proportioned, Too

Even correct foods may produce bad results unless they are properly combined and proportioned. An excess of sweet elements clogs the liver, a deficiency causes unrest. In correct combinations they digest easily so that there is no desire to overfeed.

Underfeeding vital foods will cause loss of brain power and memory, lack of ability to concentrate, nerve-hunger or neurasthenia. I can tell you *exactly* what to eat to revitalize your nerve system, recreate body energy and restore brain activities. Whether you are well or sick, I can help you to greater activities, greater usefulness, a more active and more enjoyable life. My Booklets have taught many how to help themselves by applying the principles of the Brainy Diet System.

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ORLAND J. RIDENOUR, President. W. G. RIDENOUR, Secretary. AUSTIN C. LESCARBOURA, Editor.

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Modern Electrics and Mechanics

VOL. XXVIII. February, 1914 No. 2

Modern Industrial and Military Explosives

A Brief Account of the Composition, Characteristics and Methods of Employment

By Charles Heilman

Illustrations by courtesy of the E. I. du Pont de Nemours Powder Co.

PART ONE

THE use of explosives—every day more extensive and daring—has increased in an incalculable proportion. If it is necessary to take a fortified place, project a half ton of steel ten miles, pierce a mountain, annihilate an island, prepare the ground for planting, or yet to provide a flying machine with an invisible team of one-hundred horses which barely weighs 400 pounds, it is by the application of an explosion that the human genius realizes these modern wonders.

But even with the universal employment of various explosive forces for many diversified tasks the average layman regards an explosion as an irregular and lawless phenomenon. Yet all

A MODERN EXPLOSIVE FACTORY, SHOWING THE ISOLATION OF THE BUILDINGS

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explosions follow certain well-defined laws in chemistry and physics. To better understand the actual working of an explosion it is necessary to analyze it in a scientific manner as far as its complexity will permit, forgetting the dramatic appearances of the phenomenon.

Although explosions may be of different varieties, they all embody the same physical characteristic—the formation of a gaseous mass at a high pressure and, in general, at high temperature at the source of the explosion. It is this gaseous mass that causes the shattering, breaking and annihilating of confining walls through its expansion and pressure.

Possibly no better example of an ex-

BLASTING AN ICE GORGE IN THE SUSQUEHANNA RIVER

plosion on a small scale could be found than the toy wooden pistols or cannons fitted with corks. When the cork is securely tightened in the mouth of the cannon and the rod, connecting with the piston, gradually pushed, the imprisoned air between the piston and the cork is compressed until the pressure reaches a point where the cork is violently ejected and the air allowed to expand into the atmosphere. This action is accompanied by a slight detonation. In this instance the phenomenon is of the simplest form; no chemical change of any kind being necessary and no heat present.

Another simple example of an explosion is presented in an experiment using a glass test tube in which water has been placed and sealed securely. When the tube is clamped in a stand and placed over a bunsen burner flame the water is quickly brought to the boiling point and is transformed into steam. If the action is permitted to continue, the steam soon reaches a pressure where the walls are no longer capable of withstanding the strain and are shattered. The steam then escapes into the atmosphere. In this instance the action is more complicated than in the case of the compressed air cannon or pistol, although they resemble each other in the essential that no chemical change has taken place. In the latter instance, however, heat has been present and has brought about the explosion.

But it must be borne in mind that these are exceptions rather than the rule. Nearly always, explosions are caused by a chemical reaction that is violent and rapid and suddenly produces an enormous quantity of heat as well as a large volume of gas. If the reaction is confined in a closed vessel, the gaseous mass attains pressures that are sufficient to burst the walls of the container if the latter does not possess the right degree of tensile strength.

The ideal case, however, is one in which the explosive is imprisoned in a container whose walls can resist the pressure and heat accompanying the phenomenon. If, in such a container, an explosive substance or mixture is placed, it is possible to compare the relative power of the different explosives by measuring the pressure of the gas in the vessel after the explosion. In modern practice the measuring of explosive pressures is accomplished by the crushing of small lead or copper cylinders that are conveniently graduated and known as "crushers." Considering the space or volume occupied by the gases emanating from the explosion as the factor of comparison, it will be immediately appreciated that the greater this volume is the greater the pressure in the vessel. On the other hand the pressure increases also with the temperature and consequently with the degree of heat generated by the reaction. It therefore follows that explosives can be compared to determine their relative strengths by the volume of gas they will produce when exploded as well as the quantity of heat they generate.

The greater the density of the charge

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the more violent will be the effect of the explosive. This fact accounts for the reason why fulminate of mercury, the density of which is five times that of black powder and three times the density of nitro-glycerin, can furnish by its explosion pressures of 27,000 atmospheres—at least three times as great as pressures attained by any other explosive.

In the foregoing discussions there is an important factor in the technology of explosives that has been omitted thus far, and that is the duration of the reaction. In the ideal hypothesis of a closed vessel from which neither heat nor gas can escape the duration of the reaction is of no importance. If it is for an hour or a thousandth part of a second it matters not for the final pressure will be the same. But in practice things are different. If the reaction is too slow, the heat created will scatter entirely or in part to the exterior by conductivity and radiation. Furthermore, there is no practical application where the gases when heated do not expand, whether this phenomenon is produced in the open air or surrounded by walls, and escape into the atmosphere. In an explosion produced in open air, if the phenomenon is slow the gases scatter into the atmosphere by degrees without attaining a high pressure. But if the explosion is nearly instantaneous, as in the case of fulminate of mercury, the gases form a volume hardly greater than the volume occupied by the explosive and expand with great violence, communicating to the surrounding atmosphere such pressures and velocities that they produce the same destructive effects as if they were surrounded by solid walls.

Between instantaneous and slow explosives there exists a long line of explosives: very fast, fast and moderately fast. The first class of explosives produce powerful results in the open air. But experience demonstrates that the rapidity of the reaction increases very fast with the temperature and the pressure. Consequently, if a slow explosive is fired in a receptacle of considerable resistance the phenomenon will accelerate, and when the receptacle gives way the production of gas will have become so rapid that it will produce shattering effects. Accordingly, when the miner drills a bore hole to be used for a known explosive, the slower the explosive the deeper and tighter must the hole be made in order to secure the maximum efficiency. The hole must also be well filled with the explosive charge.

The influence of the duration of the reaction appears in the best known applications. The burning of coal offers a very striking example. A kilogram of coal when burning delivers a gaseous product and 8,000 calorics in heat while a kilogram of ordinary dynamite gives off only 1,300 calorics. Yet pieces of coal in the presence of the atmosphere do not constitute an explosive because the combustion is too slow, the coal burning only at the surface and the center being reached only

BLASTING A RAILROAD CUT ALONG THE SUSQUEHANNA RIVER

after a while. But if the coal is divided into extremely small particles so that oxygen can come in contact with each one, the resulting mixture of gas and coal dust is explosive since the combustion of all the coal requires only an instant. This is known as fire damp in mines.

In order to qualify as an explosive, a substance or a mixture must be capable of very rapid reactions which throw off an abundance of gases and at the same time a great quantity of heat.* Consequently, explosives may be defined as bodies that possess the property, when heated, set on fire, or subjected to other treatment, of being converted from

* There are some mixtures that throw off a great volume of heat but no gases, and consequently are not explosives. As an example, probably none is more striking than Thermite, a mixture of powdered aluminum and iron oxide (or of chromium) which throws off sufficient heat to melt iron, weld iron rails, etc.

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their solid or liquid state into gases in an almost unmeasureable short space of time; such gases liberating heat during the chemical action and in consequence highly expanding and through this expansion exerting a great pressure on their surroundings. This conversion is accompanied by a detonation which is termed as the "explosion." The shorter the space of time in which a certain quantity explodes the larger the volume of gases developed by the explosion and the greater the heat developed the stronger the explosive. But there are different factors which determine the rapidity of an explosive reaction, viz.: the chemical nature of the explosive, its physical condition, the condition under which it is exploded and the method of firing. The energetic action of an explosive largely depends on its rate of chemical change. In chemical compounds, such as nitro-glycerin and gun-cotton, the reacting atoms are in much greater proximity than those in a mechanical mixture of solids such as powder, and in the former class the rapidity of the chemical action will be greater than that of the latter class, composed of constituents that are non-explosive by themselves.

The physical condition of an explosive has a marked effect on its ease of explosion and the character of the phenomenon. For instance, frozen nitro-glycerin is much less sensitive than the same explosive in the liquid state, while the same gunpowder mixture will give various effects according to the size of the grain.

Confinement increases the effects of all explosives, the more rapid the reaction the less confinement being necessary to obtain the maximum effects. The power of mercury fulminate, for instance, is but little increased by confinement, while on the other hand explosives of the gunpowder type require to be strongly confined to produce disruptive effects.

But to successfully employ various explosives it is necessary that the reaction can be produced at will by an easy method. The explosive reaction may be begun by a heated solid, a flame, friction, by percussion, an electric current or spark, the concussion from another explosive, or from chemical or physical change. The nature of the reaction is largely responsible to the method of firing adopted; nitro-glycerin or gun-cotton in contact with a flame burns quietly in the open, but when fired by the detonation of a small initial charge of mercury fulminate the whole mass of the explosive decomposes practically instantaneously and detonation results.

DYNAMITING ROCK IN THE CONSTRUCTION OF THE "SOO" CANAL

THE DIFFERENT KINDS OF EXPLOSIVES.

Explosives, as we have just defined them, can be of different kinds. First of all, we have the mixtures of simple

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substances having powerful affinities for each other; for instance, the gaseous mixture of hydrogen and oxygen. To produce an explosion it is sufficient to only approach a flame to where the two gases meet. In this example, the reaction is a combination of hydrogen and oxygen, that is, a combustion of hydrogen. In fact, combustion plays a pre-eminent role in most all explosions, although it is not absolutely necessary. A balloon containing hydrogen and chlorine will burst as soon as exposed to sun rays; the reaction in this instance being a violent combination of the hydrogen and the chlorine, produced by the light.

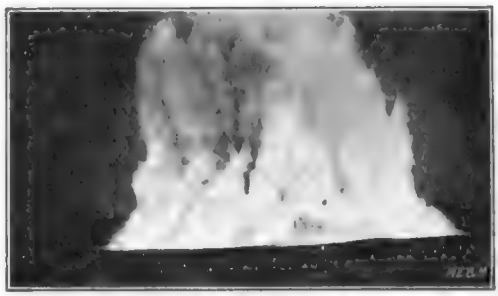
In other cases the explosive is a chemically defined substance the molecules of which have undergone a sort of forced union and are always ready to break away. So it is when iodine is mixed with a solution of ammonia it combines with nitrogen and absorbs heat. This mixture, as soon as dry, detonates at the least shock, at the least friction; the iodine and nitrogen resume their independence in restoring violently the heat which their combination had absorbed. It is a most excellent shattering explosive.

But in most common explosives it is the combustion that is the source of the heat produced. For instance, the

BLASTING DOWN THE ENTIRE FACE OF A QUARRY

old black powder is a mixture of carbon, sulphur and saltpeter in the proportions of one part carbon, one of sulphur and six of saltpeter. The saltpeter plays the role of reservoir for the oxygen. It is an unstable composite, very rich in oxygen and ready to part from it under the influence of suitable firing. The carbon and the sulphur are combustible substances which greedily take possession of the liberated oxygen.

Likewise, nitro-glycerin, a nitrogen substance containing much oxygen, is



BLASTING IN THE DETROIT RIVER

readily decomposed under the influence of a shock into oxygen, nitrogen and combustible elements (carbon and hydrogen), which unite violently with the oxygen to form carbonic acid and vapor. The nitrogen remains free as well as an excess of oxygen. All the products of the reaction are gaseous and brought to a high temperature by the heat of the combustion.

Explosives of this nature (whether they are chemically definite substances or mixtures) contain always molecular combinations very rich in oxygen and unstable, at the same time as combustible elements. The priming provocates an initial disengagement of oxygen and starts a violent combustion.

DISCOVERY AND PROPERTIES OF BLACK POWDER.

Nothing definite is known as to who discovered black powder, where and when it first came into use. "Greek fire" is said to have been employed in the defense of Constantinople in the seventh century, and that fiery composition (mixture of rosin, pitch and bitumen, rendered explosive by the addition of saltpeter) was propelled against the enemy by means of arrows from bows, or in hollow vessels of stone or iron thrown by war engines. "Greek fire" paved the way to the first test of black powder in the pioneer cannons. Arabians were the first to make a gunpowder-like mixture, probably about 1280 A. D., while the idea of using the propulsive force of this mixture (that

(Continued on page 252)

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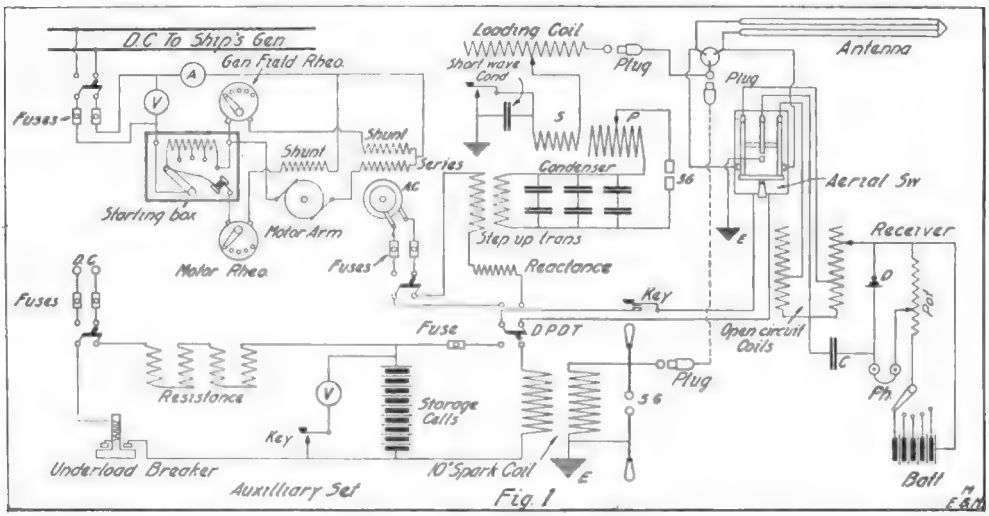
New Marconi Marine Sets

A Description of the Synchronous and Non-Synchronous Wireless Sets Now Used on Coastwise Ships

By Stanley E. Hyde

IN this article the author has endeavored to describe the wireless apparatus installed on many ships both on the Atlantic and Pacific oceans by the Marconi Wireless Telegraph Company of America. A great percentage of the vessels do not have a complete set of one type of apparatus, but generally have their sets made up of a combination of different types, as will be shown.

Figure 1 shows the complete wiring for a type of apparatus used in both land and ship stations. Where there is no available supply of alternating current, as is most always the case on ships, a motor-generator must be employed to change the direct current to alternating. The motor generator consists of a direct current motor, driving an alternating current dynamo. To make the unit compact the armatures of both are mounted on the same shaft and also on a common base. It will be noted that above the generator armature are two field coils, one marked "series" and the other "shunt." The series winding is connected in series with the D. C. armature, and the shunt winding is connected in shunt with the D. C. line through a field rheostat. With such an arrangement of the field windings, the voltage is maintained more constant than could be accomplished otherwise. The starting box is of the Cutler Hammer type, and it serves to prevent an enormous rush of current while the motor is being started. The small electro-magnet, M, holds the switch arm over by virtue of its attraction for a small piece of iron mounted on the switch arm.



COMPLETE WIRING DIAGRAM FOR MARCONI APPARATUS USED IN LAND AND SHIP STATIONS

An ammeter and volt-meter are in the circuit to indicate the pressure on the line and the current used by the motor and field coils of the generator. The speed of the motor is adjusted by the motor field rheostat. For instance, if the resistance in the rheostat is increased the motor will speed up for the reason that the armature does not generate so much counter E. M. F., the result being that a larger volume of current passes through the armature windings making it rotate more rapidly. The voltage of the generator is controlled by the generator field rheostat, for if the resistance is increased the

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number of lines of force cut by the generator armature will be decreased, thus lowering the voltage of the current generated.

It will be seen that the current from the generator must pass through the aerial switch, Morse key and a reactance coil before it reaches the step-up transformer. The auxiliary set will be described later. The transformer is of the open core type. Across its secondary terminals is connected a battery of leyden jars, usually 12 in number. Two sets of six each are connected in parallel and the two sets then connected in series. This is done in order to lessen the strain on the jars. The spark gap is mounted inside the primary of the oscillation transformer and is composed of two straight rods tipped with an alloy that wears down evenly.

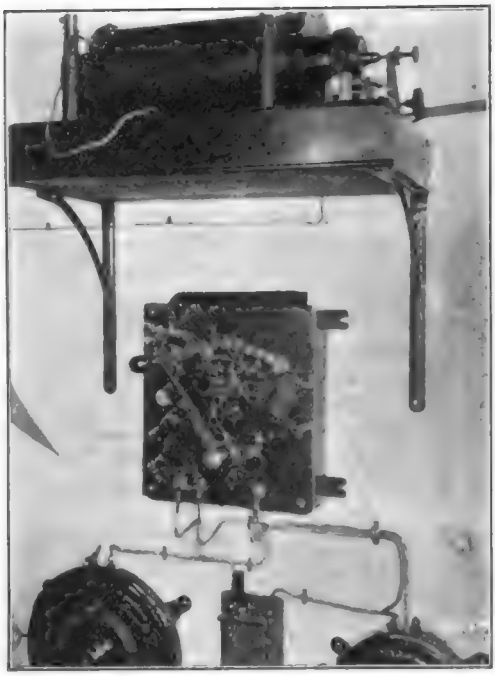

FIG. 2.—A VIEW OF THE TEN-INCH COIL

Before the radio law was passed close coupling was employed, but now that loose coupling must be used to insure a pure wave, the old helices formerly used for close coupling have been remodeled and by the addition of a secondary composed of four turns of stranded wire mounted on a wooden frame above the primary, a very efficient oscillation transformer is produced.

In series with the ground wire will be noticed a condenser. This is called the "short wave condenser" and enables a wave of 300 meters to be sent out if necessary. This is done as follows: On the primary of the oscillation transformer and also on the loading coil are two little metal tabs, one being punched with the number 300 and the other with the number 600. These indicate that the radio inspector has previously tuned the set for 300 and 600 meters, respectively. Ordinarily the 600 meter wave is used. In order to change to 300 meters the helix clip on the primary is moved to the turn on which the 300 meter tab is located. Now the closed oscillatory circuit is generating waves of 300 meters wave length. Next, the open cir-

A TYPICAL RECEIVING SET ON COASTWISE STEAMER

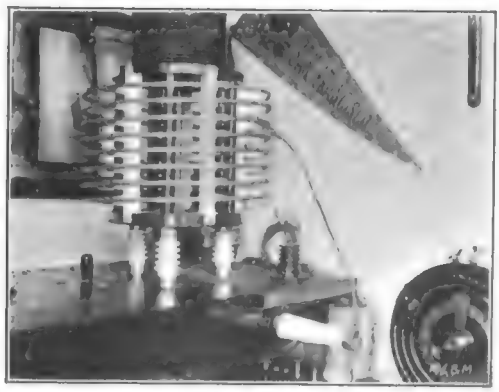

FIG. 3.—THE OSCILLATION TRANSFORMER OF SHIP SETS

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cuit, composed of the antenna, loading coil and secondary of the oscillation transformer, must also be tuned to 300 meters. The clip on the loading coil is moved to the 300 meter tab. Then the switch shunting the short wave condenser is opened, thus cutting the condenser in series with the open circuit. Now the transmitter is ready for sending out 300 meter waves. This is all

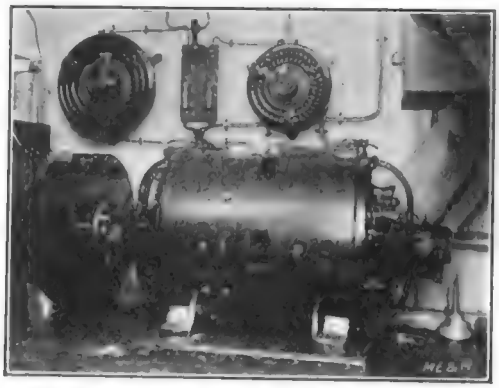

FIG. 4-A. — THE MOTOR-GENERATOR WITH ENCLOSED SYNCHRONOUS GAP

done in a few moments, and without the use of a hot-wire ammeter, for the circuits have been previously tuned with a standard wave meter. The antenna switch is of the old "United" type, having contacts for the use of the looped antenna.

The receiving instrument is a three slide affair, consisting of two tuning coils, a potentiometer, crystal holder, fixed condenser and three small cells enclosed in the case. The coil with the single slider is for tuning in different wave lengths and the other coil with the two sliders is for tuning the detector circuit. Of course with such a crude arrangement selective tuning, even to a very small degree, is entirely out of the question.

In another portion of the diagram will be noticed the auxiliary set for sending out distress signals. It is composed of a ten-inch spark coil operated from storage batteries. The set is divided into three parts—a ten-inch induction coil, chloride storage cells (8 to 16 in number) and a slate switchboard on which are mounted:

A D. C. switch with fuses; an underload circuit breaker; a double-pole, double-throw switch; four resistance coils in series; small battery volt-meter; a cartridge fuse in series with the discharge circuit, and a small strap key for cutting in volt-meter. The object of this auxiliary set is to furnish a means whereby the ship can communicate a distance of 100 miles or more, independent of the ship's machinery.

The storage cells are charged from the ship's current through the resistance coils which cut down the E. M. F. so that it is just a little higher than the combined voltage of the cells. The underload breaker consists of a solenoid with a soft iron plunger on the bottom of which is a copper contact plate. When the plunger is drawn up the copper plate makes contact with two lugs and the charging current is connected to the cells. It will be seen that if the current from the line should be cut off for any reason the plunger will drop down and open the circuit to the cells. The plunger will also drop if the voltage is reduced below a certain value, thus affording protection to the charging generator and cells. If an underload breaker were not employed, the batteries would then be likely to discharge through the generator if it stopped for any reason and probably reverse its polarity, besides being very rapidly discharged themselves, resulting in probable injury to the plates.

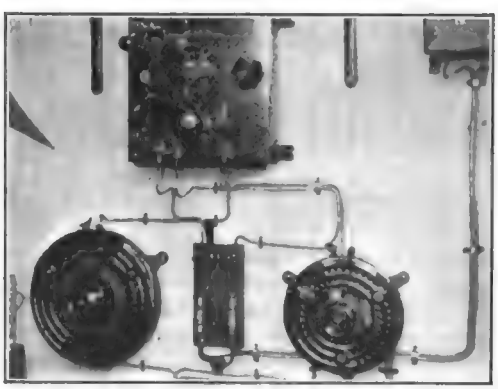

FIG. 5.—THE MOTOR STARTER AND FIELD CONTROL RHEOSTATS

When it is necessary to operate the coil the plug from the anchor gap to the loading coil is removed and the one to the spark coil is plugged into the receptacle. The other side of the spark gap is permanently grounded. No condenser is used across the termi-

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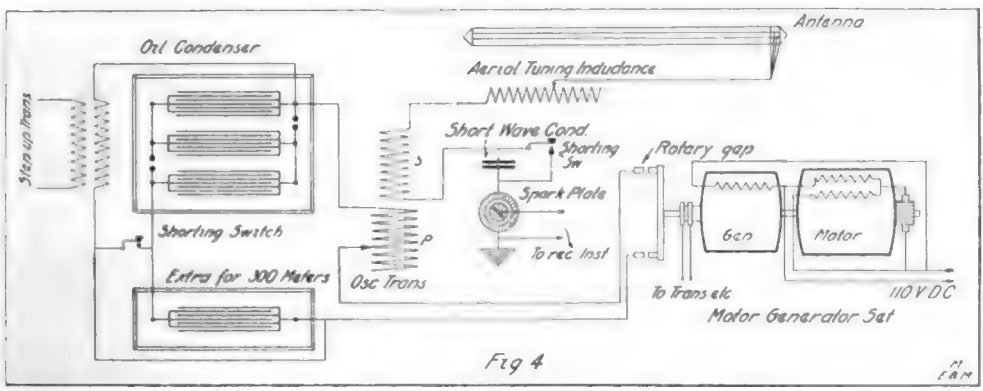
nals of the coil as the capacity of the antenna is sufficient for this purpose. The aerial switch is then thrown to the sending position and the D. P. D. T. switch connecting the key is thrown over to the other side where it connects the key and aerial switch in with the battery circuit. In Fig. 2 will be seen a view of the ten-inch coil. The starting box below has nothing to do with this coil, however, but connects with the regular motor-generator set.

All windings, such as armatures, field coils, etc., are protected by an arrangement that consists of a carbon rod having a resistance of 500 ohms, which is connected across the armature terminals. The middle of this rod is connected to earth. To low frequency and direct currents this rod has a high resistance but to high frequency currents the rod has a negligible resistance and



WIRING DIAGRAM FOR THE SYNCHRONOUS SETS NOW IN USE ON MANY STEAMERS

they are readily conducted to earth.

The 240-cycle synchronous sets are very compact and nearly as efficient as a modern quenched spark system. They are installed on many of the coastwise vessels on the Pacific Coast and invariably have a greater range than similar sized sets of the non-synchronous type.

The hook-up for the synchronous system is shown in Fig. 4, without the usual starting devices which are essentially the same as for the ordinary system shown in Fig. 1. The alternator has a frequency of 240 cycles and directly connected to the shaft is a rotary spark gap. The gap has as many sparking points as there are pairs of field poles and these are so adjusted that when the current from the alternator charges the condenser to a maximum, a point comes opposite the stationary electrode and a spark occurs. This keeps the spark in synchrony with the condenser discharges and the maximum energy is obtained. Fig. 4-a shows the motor-generator with the synchronous gap enclosed on the left. The advantage of this gap lies in the fact that a pure musical note of high pitch is emitted which is easily read through interference and at the same time the gap is efficiently cooled, thereby keeping the antenna radiation constant. The stationary electrodes are kept as close to the rotating disc as possible. It will be seen that there are three condensers in series in order to reduce the strain on the plates and also to lower the wave length. These condensers consist of flat plates of glass covered with tin foil and immersed in a tank of oil. In the 2 kw. type the condenser consists of 36 plates made up of three units of 12 each, connected in series as shown. Safety gaps are placed across the condensers to protect them from destructive voltages.

The oscillation transformer is of the inductive coupled type and has a secondary that slides in and out of the primary, as shown in Fig. 3. The spark plate is made of two brass plates separated by a very thin piece of mica, and is shunted by the receiving instruments.

In Fig. 5 is shown the type of control in general use for average ship sets, the same consisting of two field rheostats, line switch and a starting box. It will be well to note that all the wiring of these sets is now enclosed in lead

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tubing which is grounded. This grounds the static charges before they reach the copper wire inside the tubing, preventing destructive sparks that would pierce the insulation of the motor and generator windings. Of course, the copper wire inside the tubing is heavily rubber covered so that contact does not occur between the wire and lead casing.

The aerial tuning inductance is similar to the other sets and consists of a helix of stranded phosphor bronze wire wound on a hard wood frame. It has twenty-four turns. It serves for tuning the open oscillatory circuit to the same period as that of the closed.

It will be observed that there is an extra condenser connected in series with the main condenser and shorted by a switch. This auxiliary capacity is used for bringing the wave length down to 300 meters when necessary, by cutting it in series with the main condenser. It can also be used in emergencies when the regular condenser breaks down.

In both the synchronous and non-synchronous sets the receiving units are the same and are shown in Fig. 6. There is no need of describing the oscillation valve or audion detector as it has been fully dealt with in this magazine before. It is found that a certain degree of heat from the filament is necessary to produce the most sensitive results, consequently a rheostat is included in the circuit with the batteries and the lamp filament so that the glow of the filament can be varied to suit requirements.

The "standby circuit," for the purpose of listening to all stations, will now be described. When the D. P. D. T. switch is thrown to the left and antenna and earth connections are thrown to contacts 1 and 3, it will be noted that the intermediate circuit and the primary circuit P are disconnected and a special primary winding A is connected into the open circuit. A is an inductance with a fixed value that is wound closely around the inductance S' of the detector circuit. In this manner a very tight coupling is secured that permits of receiving varying waves over a wide range of wave lengths. Contacts 5 and 6 close the battery circuit. Before transmitting the triple switch is opened thereby breaking all contacts, the current to the filament being also cut off. On the sending key will be noticed two extra contacts that close just before the primary circuit does. These shunt the head phones, thus protecting them from burning out. When the switch is thrown to the right the intermediate circuit or tertiary circuit, as it is sometimes called, is cut in and secures selective tuning. The reason for securing sharp tuning from broad waves is because of a very low resistance in this circuit, hence, however broad may be the waves traversing the open circuit, they will induce in the tertiary circuit oscillations of the same wave length, but of relatively low damping, i. e., the waves will be sharper. Of course, loose

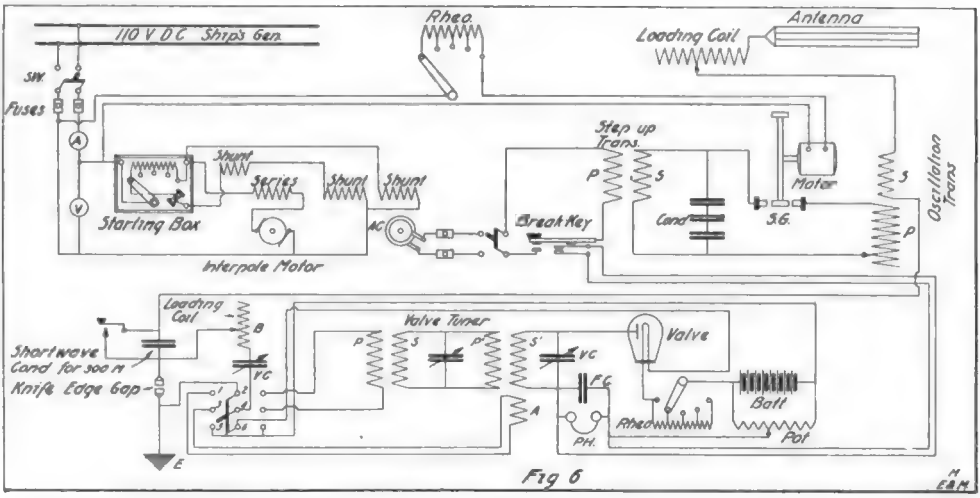

Fig 6

WIRING DIAGRAM OF THE TRANSMITTING AND RECEIVING SETS EMPLOYED ON COASTWISE STEAMERS

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coupling must be obtained if this selective tuning is a requisite. Tuning of the open circuit is accomplished by the loading coil B and the variable condenser VC. Tuning of the intermediate circuit is accomplished by the variable condenser X, which is of large capacity.

The only difference between the synchronous and the non-synchronous sets is in the type of rotating spark gap employed. The synchronous has been already discussed. In Fig. 6 it will be seen that the disc is rotated by a separate motor, controlled by a small rheostat. The disc is made of a mica composition and has studs around its periphery in a plane parallel to the shaft of the motor.

In comparing the synchronous transmitter with other spark sets a great difference, especially in the tropics, is noticed, for with an ordinary spark transmitter rarely over a hundred miles can be covered while with the high pitched and pure spark of the synchronous sets many times this distance can be and is constantly covered.

Armatures Wound by Novel Machine

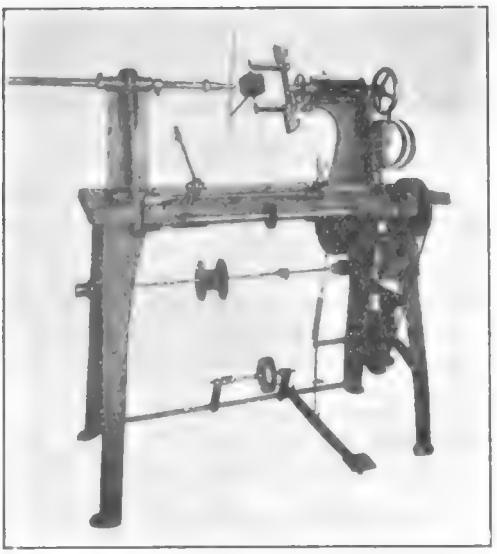
By C. L. Edholm

A NOVEL machine for winding armatures has been invented by a Los Angeles man and it is claimed that its use will result in far more accurate, rapid and economical work than resulted from the old style hand winding. The inventor claims that it will handle any sized armature from a vibrator to a 1½ H. P. motor. The coil former attachment eliminates the ordinary wooden frame and is adjustable to any sized coil or wire, from a 1 H. P.

A TYPICAL SCENE IN AN ELECTRICIAN'S SHOP—WINDING MOTOR ARMATURES BY HAND

to a 50 H. P. It is claimed that only one-tenth of the time is required for winding by this new device.

The coil taper is readily adjusted and tapes the coils to any given thickness with accuracy and speed. The ring armature winder is adjusted with equal readiness and will do six or seven days' work in as many hours. The wire guider makes for accuracy, ease and



VIEW OF THE RECENTLY INVENTED MACHINE FOR WINDING SMALL MOTOR ARMATURES

speed in winding fields, solenoids and coils of various designs and high tension secondaries. The wire is wound without touch of the hand, resulting in freedom from kinks and uneven tension. The machine is operated by foot lever and friction clutch. It has been examined and approved by leading electrical concerns in Los Angeles and other parts of California, which have contracted for its use.

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New Canadian Wireless Stations

By D. A. Nichols

THE public has heard very little of the new and up-to-date radio installations of the Canadian Marconi Company on the upper great lakes. At present these consist of five stations as follows: VBA Port Arthur, VBB Sault St. Marie, VBC Midland, VBD Tobermory, and VBE Sarnia, all situated on the Canadian shores of Lakes Huron and Superior.

EXTERIOR OF THE OPERATING BUILDING

The stations are of the latest type of pronounced English design, and are models of efficiency and reliability. The accompanying photographs are of the Port Arthur station, but as all the sets are identical in general design they may be taken to represent all of the five stations.

The antenna of the Port Arthur station is of the T type, 440 ft. long, and is supported by two three-section wooden masts 200 ft. high and 550 ft. apart. It consists of two heavy stranded phosphor bronze wires on 20-ft. spreaders. The earth connection is of the radial wire type and consists of 60 wires.

The exterior of the operating building is clearly shown in one of the accompanying views. This is a neat, one-story brick dwelling, with cellar beneath for storing supplies. The interior of the building consists of three rooms, transmitter room, office and instrument room, all opening into the front vestibule.

Duplicate transmitters are provided, which are shown in one of the illustrations. A more detailed view of one of the transmitters is also given. Each transmitter consists of a motor generator for converting 600-volt 60-cycle a.c. into 440-volt 240-cycle a.c.; 5½ kw. closed core transformer; oil immersed condenser; primary tuning inductance; transmitting jigger, and aerial tuning inductance. The synchronous rotary discharger, which is enclosed in a metal case on the end of the generator shaft, discharges the condenser 480 times per second.

In case the current supply should be cut off either generator can be driven by the 8-h.p. gasoline engine, which just shows in the foreground of one of the illustrations.

The receiver and controlling switchboards are shown in another view. The two motor starters can be seen at the base of the large switchboard, and either

TWO VIEWS OF GENERATING SETS AND TRANSMITTING APPARATUS, SHOWING THE MOTOR-GENERATORS, GASOLINE ENGINE AND SENDING EQUIPMENT

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transmitter can be controlled from here. The small switchboard shown in the background of this view controls the storage cells used in connection with the valve detectors. The valve tuner with the magnetic and valve detectors comprises the receiver, and as the break-in system is employed, no antenna or change-over switch is required.

These stations are very efficient. The Sarnia transmitters radiate 24 to 27 amperes, and they have all shown up well under test. At night the signals between Sarnia and Port Arthur, 600 miles apart, are very strong and distinct, and as the spark has a clear, musical note, it is easily read through static disturbances. Normally these stations work on a 600-meter wave length, but under special conditions and for long-distance overland transmission 1,500 meters can be used, the aerial tuning inductance, which is ordinarily out of circuit, being then connected in the open circuit.

A record was recently made by Mr. D. Manson, officer in charge at the Sarnia station, when on the night of November 25, he picked up signals from Darwin, near Palmerston, Australia, which station was calling the station at Sydney, Australia. Although the distance covered is nearly half-way round the earth, Mr. Manson stated that the signals were quite clear and distinct. Unless the writer is mistaken, this constitutes a world's record in long distance receiving.

OPERATOR'S TABLE, SHOWING RECEIVING APPARATUS AND CONTROLLING SWITCHBOARD

Institute of Radio Engineers

AT the meeting of the Institute of Radio Engineers, held on December 3, 1913, at Columbia University, Mr. E. F. W. Alexanderson, of the General Electric Co., well known as a pioneer in the building of high frequency alternators, delivered an address on "Dielectric Hysteresis at High Frequencies." He discussed the method he used for measuring dielectric hysteresis at high voltages and high frequencies, gave a number of the results he had obtained, and deduced some general laws governing these phenomena.

The main part of Mr. Alexanderson's paper consisted of the description and discussion of a transformer designed to operate on 100,000 cycles (from a high frequency alternator) and to transform up to 100,000 volts. He described the troubles he experienced in obtaining such an instrument, which in itself should have losses so low that they should be negligible beside the losses through hysteresis in the dielectrics under test. The final form in which it was built had 0.3 per cent. losses. In it hysteresis losses were reduced to a minimum by the elimination of iron (an air core was employed), and by the use of "pancake" coils wound in a peculiar manner with bare wire separated by layers of cotton. The type upon which the whole transformer was based was not of the ordinary "primary-secondary" construction, but was an oscillation transformer, in which high potentials were produced at certain points of the circuit. The connections in the transformer are shown in Fig. 1. The high frequency generator G is connected to the inductances L_1 and L_2 and these to condensers C_1 and C_2. In the apparatus these condensers were shields around the trans-

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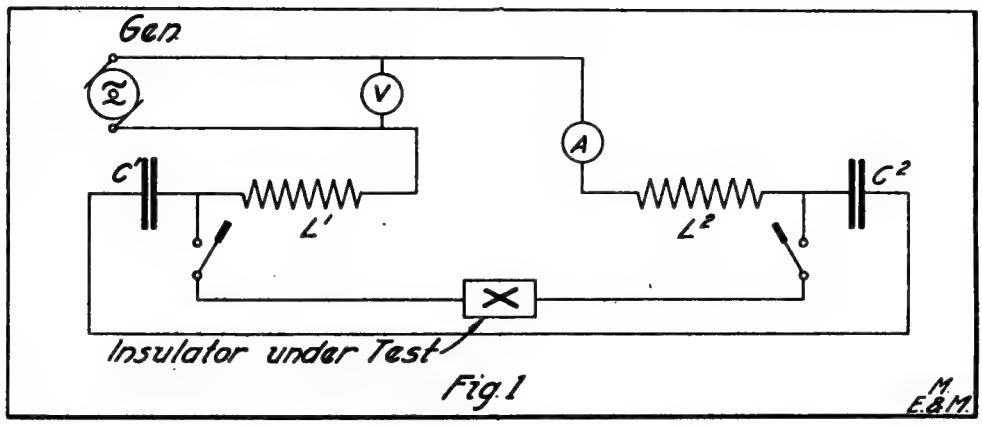

former to prevent losses by radiation. They consisted of copper wire spirals which in themselves had sufficient distributed capacity to act as condensers. The condensers and inductances of the circuit were in resonance so that there would be no energy component in the circuit when the current was flowing other than that caused by losses in the insulator under test. The different current, which passes through the circuit when the dielectric to be tested is connected in as shown, is then that caused by losses in the dielectric. Thus by noting the ammeter and voltmeter readings before inserting the dielectric, and, keeping either current or voltage constant, after inserting the dielectric, the difference in readings will show the energy consumed by the specimen tested; this may then be expressed as a power factor introduced by the specimen, from the generator's "characteristic" curves.

Some of the results obtained by Mr. Alexanderson are as follows:

Dielectric	Power Factor.
Oil	0.70 per cent.
Glass	1.25 per cent.
Mica (built up)....	6.00 per cent.
Paper	6.50 per cent.
Fibre	10.00 per cent.

It was also found that the losses were, as a rule, independent of the applied voltage but depended inversely on the frequency.

In the discussion following the paper it was shown that Mr. Alexanderson's results checked excellently those obtained by other methods.

In addition to the main speaker of the evening, Mr. R. H. Marriott announced that arrangements were in progress for transmitting waves of known wave length and decrement at definite times from one of the College of the City of New York stations so that amateurs might calibrate their receiving sets. Further information upon this matter will be published as soon as the necessary work is completed and the transmission commenced.

IMITATION PEARLS

Formerly, imitation pearls were made by coating hollow globules of glass on the inside with a varnish prepared from fish scales.

Now a process has been introduced which utilizes oyster shells for the preparation of pearls and imitation mother-of-pearl. The shells are treated with acetic acid and caustic soda until a paste is obtained. When this paste has been brought to the proper consistency, it is moulded into globules of the desired size and allowed to set or harden. The lustre is given to these artificial pearls by coating them with nitro-cellulose.

Natural pearls contain tri-calcium phosphate, but this constituent is lacking in the artificial ones. A natural pearl is made up of irregular concentric rings due to successive deposits from the secretions of the mollusk, while the imitations are more or less homogeneous.

Recently, a new process has been patented which substitutes a specially prepared mica for the essence of fish scale used in the older process. The mica is finely powdered and carefully heated until it assumes a light silver color. This heating has to be carefully done to obtain the correct color. After making this powder into globules, the pearls are made iridescent by suspending them in the vapors of tin salts.—*W. C. Dumas.*

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The Art of Bending Wood

Methods Employed in Commercial Practice as Well as Simple Means for the Amateur

By Ralph F. W[illegible]does

Illustrations from drawings made by the author.

VERSION PUBLIQUE

THE artificial bending of wood for furniture parts, interior trimming, buggy building, etc., is truly an art in itself. Great care and study have been given the different kinds of woods in regard to their bending and retaining properties and, although almost all types of lumber can be bent and will retain their shape, it is very important that the workman know what kinds will serve best for his particular purpose.

CONCERNING THE CHOICE OF LUMBER.

Straight, clear grained lumber of any kind will bend more easily than crooked, knotty stock, although the latter, in some cases, can be bent if properly treated.

A table of bending factors has been prepared by German investigators. The "strength of flexure," as it is called, for each of the common woods runs as follows:*

Name of Wood.	Strength of Flexure
Maple	7.20 to 10.90
Birch	5.20 to 9.60
Oak	4.20 to 12.20
Ash (American)	4.30 to 7.80
Ash (German)	7.80 to 11.90
Pine	6.30 to 7.98
Basswood (Linden)	6.80 to 8.10
Mahogany	6.40 to 7.30
Hickory	5.13 to 8.10
Red Beech	6.40 to 9.85
Fir	4.50 to 6.40
Elm	4.65 to 11.80
White Beech	10.01 to 12.50

These factors were determined by supporting equal sized pieces of square stock on the ends and loading them to the breaking point.

Another consideration that should be taken into account in selecting the stock is the volumetric change that the wood is capable of. The fibers, when the lumber is steamed, absorb moisture and cause the wood to swell. In this condition the bending is accomplished and is immediately followed by a rapid drying out. In drying, the wood contracts about twice as much in the direction of the annual rings than in the direction of the medullary rays. This is illustrated in Figure 1. Hence the wood will bend best in the direction of the annual rings for the simple reason that as it contracts twice as much in this direction when drying, it will expand and become more pliable in this same proportion when steamed.

Another fact which proves this assertion is that wood bent parallel to the medullary rays has a tendency to split. This is made clear in the end view of Figure 2. This is especially true in the case of wide, thick boards.

Wood that is thoroughly dried out is much harder to bend than lumber that is green, or partly dried. Such dried out stock has to be steamed in order to open the pores and widen them for bending.

THE STEAMING OF THE WOOD.

In the modern furniture factories, this steaming is done under pressure in iron retorts. Live steam is injected at the raised end of the retort, and, as the water is condensed, returns to the boiler from the lower end. In this way, very little water is lost in the process. The wood is held upon iron grates which separate the pieces and allow the steam to attack them from all sides. The length of the steaming process depends upon the condition of the lumber in the first place—whether it is green or thoroughly dried out—and the size of the pieces.

THE BENDING OF THE WOOD.

The bending machines are placed near to the retorts as no time can be lost in transferring the wood from the retort to the machine if the best of results are to be obtained. Large institutions, where uniformity of results is essential, use presses for the bending of the pieces. For instance, chair rockers are put between forms of a large press and forced into proper shape. A number are placed in the forms at one time. The sketch,

*From *Deutsche Tischler-Zeitung.*

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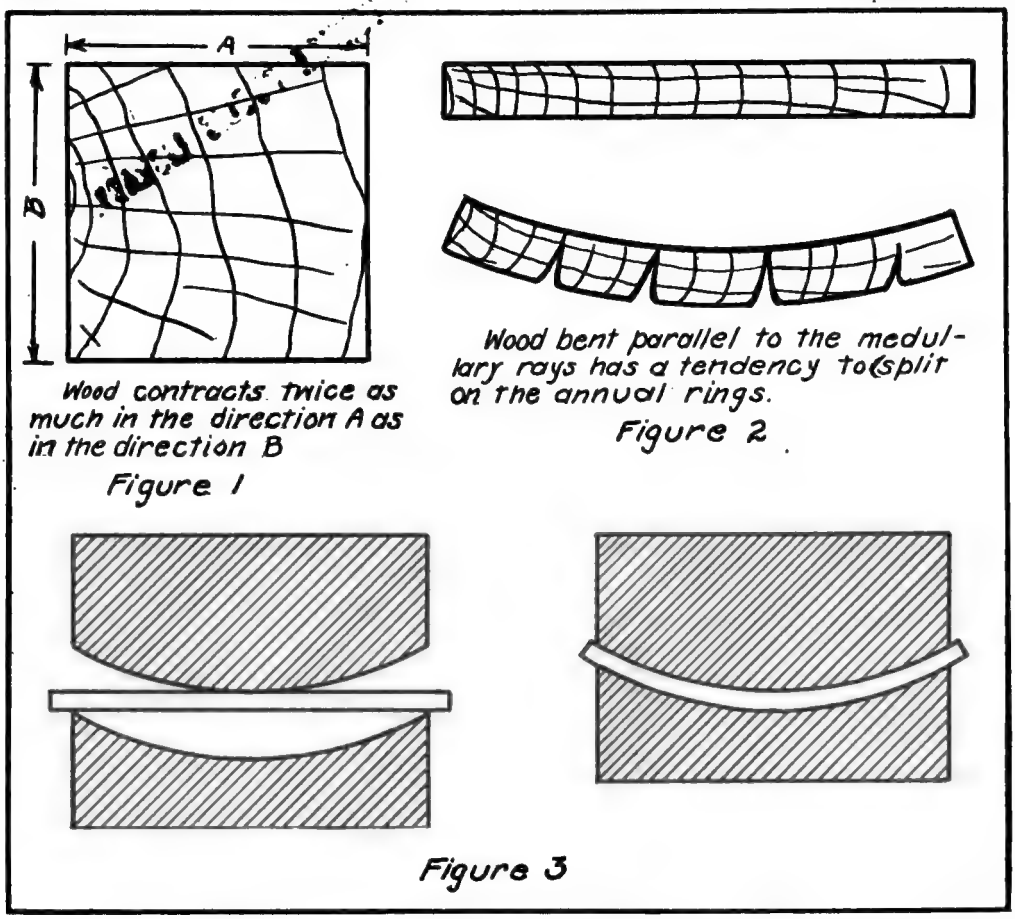
Figure 3, illustrates the action. Other parts are bent in patterns or forms of cast iron and securely wedged until dry.

After bending the wood must be dried out at once in order to retain its new shape. This is accomplished in kilns, where the process takes place slowly so that the wood may resume its internal structure before becoming case-hardened.



Wood contracts twice as much in the direction A as in the direction B

Figure 1

Wood bent parallel to the medullary rays has a tendency to split on the annual rings.

Figure 2

Figure 3

THE BENDING OF WOOD WITH SMALL EQUIPMENT.

Many amateur craftsmen are confronted with the wood bending proposition and for their benefit the balance of this article will treat upon this subject. It is not essential that the wood be steamed—it may be boiled in water—but the steaming method gives much better results.

Prepare a square box long enough to take in the longest lengths used, as illustrated in Figure 4. Some good, hard wood will be needed for this and the edges should be tinned. The wood must be an inch or over in thickness and the top and bottom securely screwed to the sides as great strength will be needed. Battens should also be fastened around the box on the ends and through the middle, as shown in the drawing. All of these precautions are necessary for the reason that when the inside of the box becomes wet, it will expand and cause the outer sides to warp and allow some of the steam to escape. This must be prevented, and, as a last resort, the outside can be wet down with water soaked cloths, which will cause it to expand with the inside, thus keeping the board straight.

One end of the box is securely fastened and a hole bored in its center for the hose. The other end is made to open with hinges so as to facilitate the inserting and withdrawing of the pieces. This end should have a small hole bored in the bottom for the escape of the condensed water.

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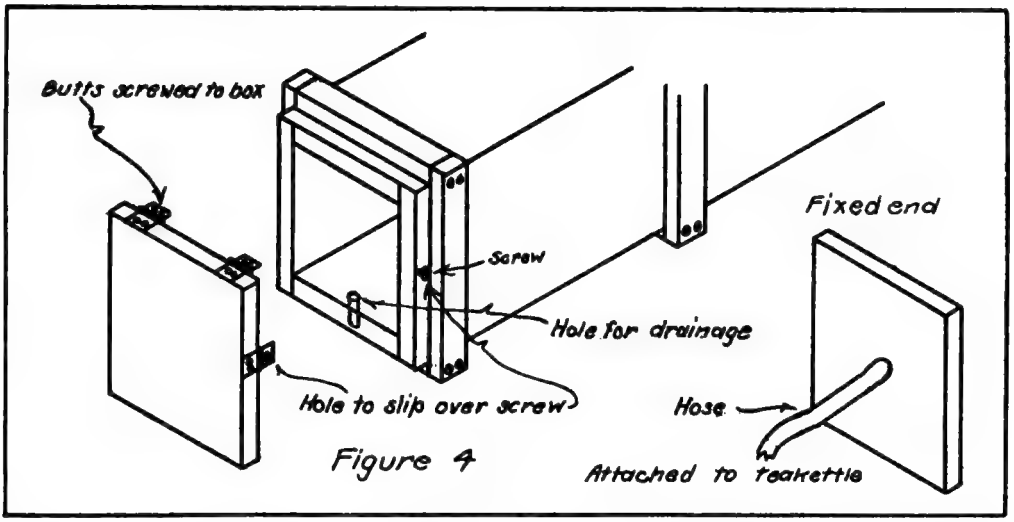

Figure 4

The other end of the hose should be attached to a teakettle spout.

The pieces of wood to be steamed are placed in the box in such a manner that the steam can reach them on all sides. This can be accomplished by piling strips between each layer, the same as in piling for seasoning.

The length of time required for steaming will vary from 15 to 20 minutes for small strips, to several hours for the larger pieces. The exact time must be determined by trial. If one end of the piece in question is tapped on a cement floor and returns a muffled, dull, soggy sound, it has been steamed sufficiently; but if it gives a clear, hard tone, it has cooled too much, or has not been sufficiently steamed.

The curve may be formed in a number of ways. One of the best is to lay out the exact shape on a flat board or a wooden floor, and screw blocks securely to this line. The steamed piece may be fastened in this form with wedges, or by means of hand screws, as illustrated in Figure 5.

Another method often used is to cut a

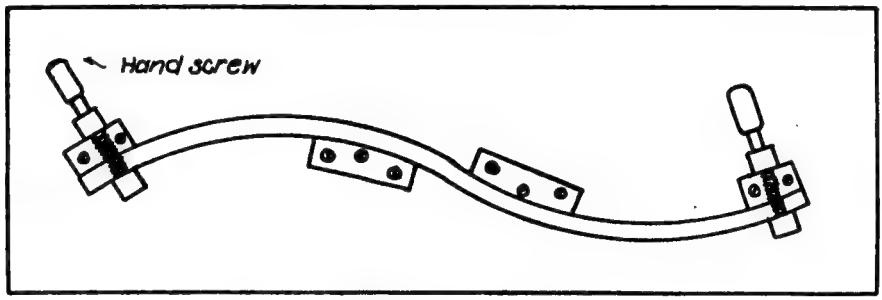

Figure 5

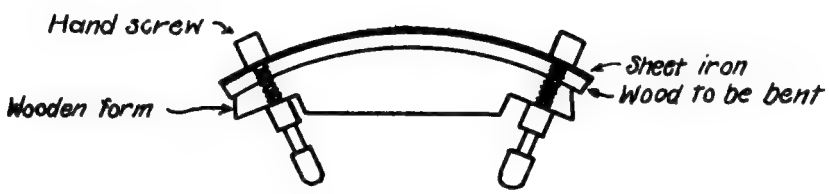

Figure 6

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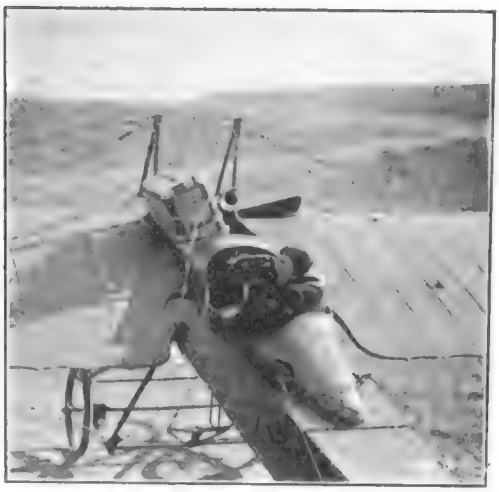
form from wood as thick as the steamed piece is wide, place the wood to be bent between this and a strip of stiff sheet iron, and clamp securely. This method is shown in Figure 6.

The wood must thoroughly dry in the forms before removing and working into the piece being constructed.

A TRUNK GOES VIA AIR LINE

A THIRTY-FOUR mile trip through the air was recently taken by a monoplane carrying a fifty-pound trunk. It was taken on by a Los Angeles aviator, W. Leonard Bonney, who secured it firmly before him in the passenger's compartment and an aerial journey was then accomplished over Los Angeles and Pasadena, the luggage being delivered in the latter city. Within a few years this means will doubtless be commonly



CARRYING A TRUNK IN A MONOPLANE

adopted for the delivery of valuable express, but up to the present time no other airman has undertaken the delivery of trunks by the air line.—*C. L. Edholm.*

TRANSATLANTIC WIRELESS TELEGRAPHY

IN a recent issue of the *Wireless World* reference is made to the progress in the erection of the great transatlantic station of the Marconi Company, which is being built near Carnavon, Wales, England, to work direct with New York.

The transmitting aerial consists of 32 wires of silicon bronze, and is supported on ten tubular steel masts each 400 feet in height. The foundations and anchors for these masts consist of very heavy concrete blocks, some 6,000 tons of material having been used in their construction. The earth system consists of two very wide circles of plates sunk in the ground, with the main building as centre. Extensions to this system are buried underground immediately beneath the aerial and extending as far as the eastern extremity of the site.

The main building is divided into two sections, the permanent transmitting section, and the experimental section. The permanent section consists of a large machinery hall which contains two generating sets of 500 h.p., and the main switchboards. On the east side of the hall is an annex in which are situated all the motor generator sets used in conjunction with the transmitting plant.

Adjacent to this hall are the two silence chambers containing the two transmitting discs, and behind these are the transformer room and various offices. This permanent transmitting section also contains spacious store rooms, workshop, and shift-engineer's office.

The experimental section adjoins the main machinery hall on the west side, and will contain various machines to be used for special work in connection with Mr. Marconi's latest device for generating continuous waves. The upper floors contain the various details of the transmitting plant.

There will be no prime movers installed in the station; all the power employed is being brought from the North Wales Power Co.'s station, near Llanberis. This station, which is situated at the foot of Snowdon, is fitted with water turbines and receives its source of supply from a lake some 1,500 feet up this mountain. The water enters the power station at a pressure of 750 lbs. to the square inch.

Power is delivered on the site to a small substation, situated near the main building, and is transformed down from 30,000 volts to 440 volts, the latter voltage being suitable for running the main motors in the machinery hall.

An efficient fire service will be installed in the building.

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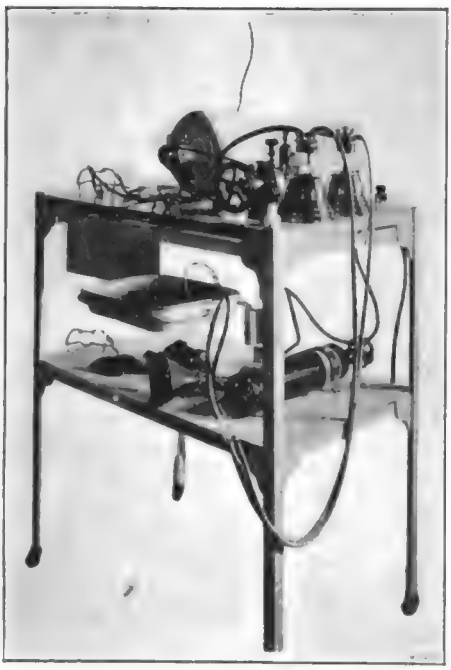
Danger of Anesthetic Eliminated By Electrical Device

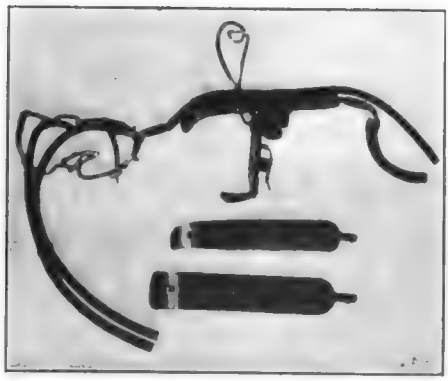
By C. L. Edholm

TWO of the greatest dangers attending the use of ether during an operation upon the throat or nose are from blood clots settling in the windpipe and causing strangulation, as well as from the effects of the cold ether upon the lungs causing pneumonia. A large number of fatalities upon the operating table can be traced to these two causes, which are eliminated by an electrical device for administering anesthetic recently perfected by Dr. Edward Kellogg of Los



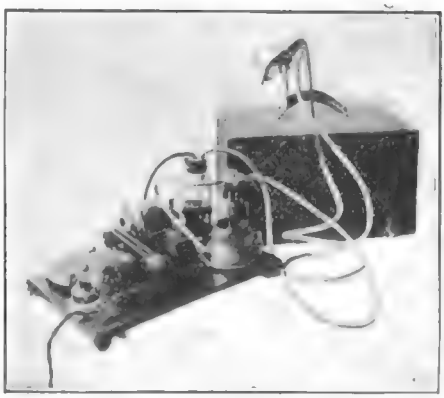
IMPROVED ELECTRICAL DEVICE FOR ADMINISTERING ETHER

Angeles. To prevent the chilling of the lungs, the ether is brought to about blood heat in an electric heater that forms part of the apparatus, the base of the ether bottle setting in the heater which can be regulated to any desired temperature. The vapor after being warmed is passed through a tube directly to the nose or throat and thence to the lungs, thus avoiding all chill. The pressure which regulates the amount of anesthetic is derived from a small pump, operated by an electric motor, which connects by rubber tubing with the ether bottle and with the metal gag fitting in the patient's



HEAD GEAR FITTED TO THE PATIENT FOR ADMINISTERING ETHER

mouth. Application of the ether is continuous to any desired amount during an operation so that there is no interruption to give more ether—a feature that was seriously lacking in the old method. The use of the mask is eliminated, except for the brief period required to bring the pa-



ONE OF THE EARLIER ELECTRICAL DEVICES FOR ADMINISTERING ETHER

tient under the influence of ether; after which the gag is used to convey the anesthetic steadily to the lungs.

The second danger, that of a flow of

(*Continued on page 234*)

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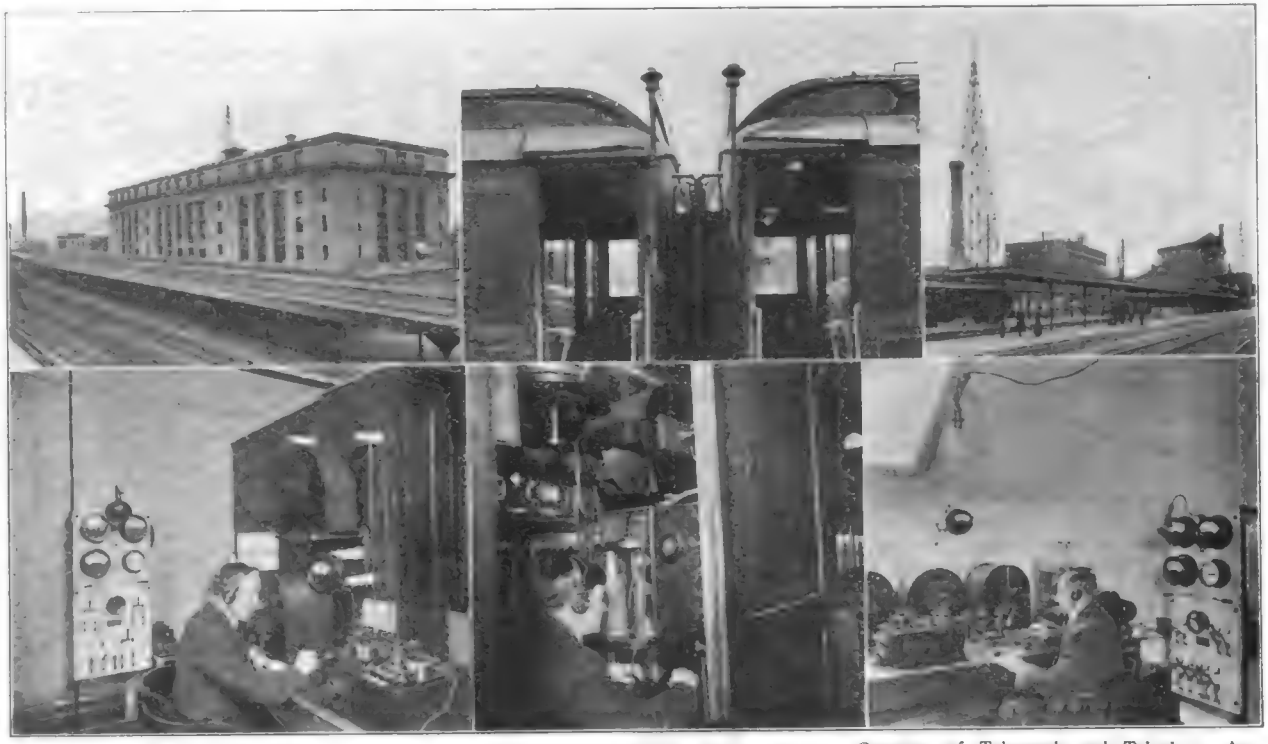

Courtesy of Telegraph and Telephone Age

Wireless on the Lackawanna Railroad

The Lackawanna Railroad has been very successful with its wireless equipment installed on one of the day express trains running between Hoboken, N. J., and Buffalo, N. Y. The set employed is a standard Marconi one-kilowatt equipment. The train can communicate with the two wireless stations located at Scranton, Pa., and Binghamton, N. Y., respectively. These two stations have a radius of about 300 miles. The station installed on the train is exceedingly compact. The aerial consists of a quadrangular closed loop on each car, supported at the corners by insulators and iron pipes attached to the ends of the car. The wires are 18 inches above the roof. Four cars are equipped with these aerials, the connections between the different sections being effected by means of a plug and socket. The aerial on each car is 65 feet long and is composed of a twisted cable of seven No. 18 silicon bronze wires. The car aerials are brought together at a point about the center of the train and lead into the station. The illustrations appearing above are, from left to right:

TOP ROW: SCRANTON PASSENGER STATION, SHOWING AERIAL; ANTENNA INSULATORS ON CARS; BINGHAMTON PASSENGER STATION AND AERIAL.
BOTTOM ROW: OPERATING ROOM OF THE SCRANTON STATION; WIRELESS STATION ON THE TRAIN; OPERATING ROOM OF THE BINGHAMTON WIRELESS STATION

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United States Motor Boat "Tarragon"

Fitted with Radio Apparatus and Employed for Enforcing the Wireless Laws.

By V. Ford Greaves
U. S. Radio Engineer, Bureau of Navigation, Department of Commerce, Washington, D. C.

THE United States motor boat *Tarragon*, of the Bureau of Navigation, Department of Commerce, which enforces the Navigation Laws, and gives especial attention to motor boats, has been equipped with a very efficient radio apparatus in charge of U. S. Radio Inspector Benjamin E. Wolf.

A VIEW OF THE UNITED STATES MOTOR BOAT "TARRAGON," SHOWING THE AERIAL

This vessel will aid in enforcing the radio laws of the United States and the London International Radiotelegraphic Convention along the Atlantic coast, with particular regard to wave length, operating and traffic regulations, as well as with a view to the reduction of interference.

The radio apparatus was designed and assembled under the direction of Mr. Frederick A. Kolster, of the Bureau of Standards. The special features of the *Tarragon's* radio equipment are compactness and facility for quick change from one transmitting wave length to another. The transmitting apparatus and motor generator are all mounted on a panel-board 32 inches wide by 30 inches high, as a single unit. The apparatus on the back of the board projects a maximum distance of 18 inches. The motor generator is operated by 20 storage cells which will supply the apparatus with current continuously on full load for about eight hours on one charge. The cells are charged by a small auxiliary gas engine direct connected to a 35 volt, 35 ampere generator. The transmitter is of the quenched gap type. A break system relay is provided which enables the operator to be "broken" or

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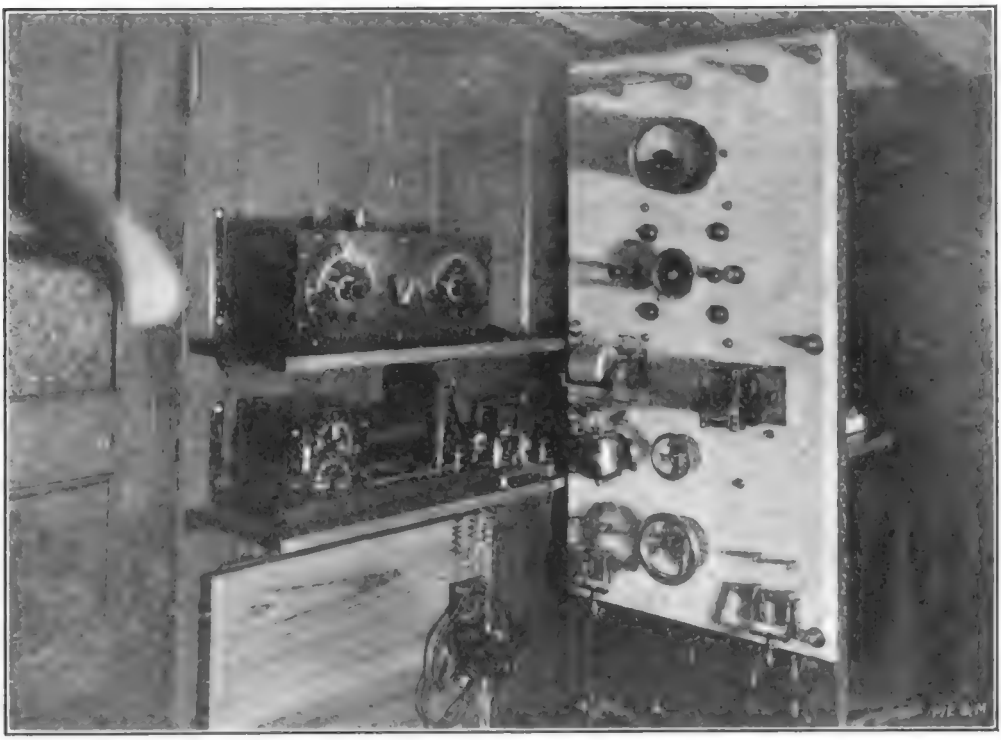
to overhear any interference while transmitting.

At present the normal wave length of the *Tarragon* is 300 meters. In addition to this, transmitting wave lengths of 200 and 450 meters are provided for. The change from one wave length to another is accomplished by a single throw of a six point switch mounted on the panel board. This single operation tunes both the oscillating and open circuits to resonance and with a slight variation of coupling, maximum radiation is obtained. The amperes into the antenna. The antenna is necessarily of the comparatively inefficient inverted V type on account of the single mast available. The maximum height above the water line is about 27 feet and the natural period of the antenna about 60 meters.

A recent test of the apparatus was conducted while the *Tarragon* was in the vicinity of Norfolk, Va. The *Tarragon* was able to plainly hear the time signals and weather report from Arlington and also the weather report being repeated by the Key West Naval



THE WIRELESS EQUIPMENT OF THE "TARRAGON," SHOWING THE RECEIVING APPARATUS AND CONTROLLING SWITCHBOARD.

wave length change device and the method of varying the coupling are very ingenious and were devised by Mr. Kolster. The receiving apparatus is secured to a bulkhead and the operating table, upon which is mounted the transmitting key, folds down when not in use. The complete installation occupies very little valuable space, even considering the comparatively small size of the *Tarragon*.

The installation is rated at one-quarter kilowatt and on the 300 meter adjustment delivers a little over three station. The press messages from Sayville, Long Island, were also copied. Communication was established over a thickly wooded country a distance of about 35 miles with the Norfolk Navy Yard station. This is an indication that the equipment will have an approximate transmitting range at sea by night of 150 miles, and the Bureau of Navigation will doubtless be able to communicate with the *Tarragon* by wireless wherever she may be along the Atlantic coast.

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A System of Compressed Air

Devoid of Any Complicated Machinery and Possessing Numerous Desirable Features

By Stephen House

Illustrations from drawings made by the Author.

SINCE the advent of compressed air as an important agent under the wise guidance of the able engineer, the most common and persistent method of its production has been a mechanical one —either the steam or electric compressor or the turbine compressor. Yet it is many years since a newer, cheaper and non-mechanical means of obtaining compressed air was to be seen demonstrated by a working model in a certain store window in Montreal. The system was more than one that worked smoothly as a model, for it was in actual operation in a Canadian city where compressed air was, and is, utilized to drive the machinery of the cotton mills. Neither steam nor turbine nor any other mechanical means finds a place in this system of air compression. The inventor has succeeded in harnessing nature in the form of a head of water and has made it supply a continuous quantity of compressed air. The water is caused to do this without any recourse to the intermediate turning of a wheel and its very simplicity is a stroke of genius.

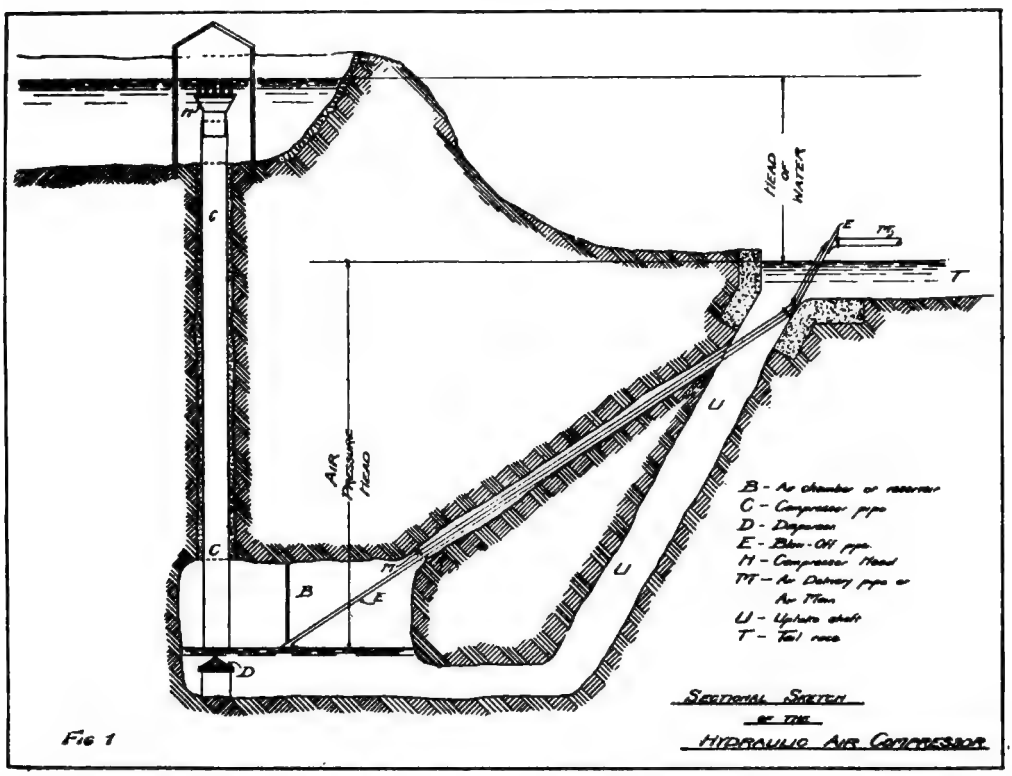
HEAD OF WATER
AIR PRESSURE HEAD
B - Air chamber or reservoir
C - Compressor pipe
D - Diagram
E - Blow-Off pipe
H - Compressor Head
MT - Air Delivery pipe or Air Main
U - Uptake shaft
T - Tail race
SECTIONAL SKETCH OF THE HYDRAULIC AIR COMPRESSOR

FIG 1

We are all familiar with the gurgling, sucking action of water as it runs out into the discharge pipe of the wash basin. We may notice how a hair or soap lather is drawn down into the vortex of this miniature whirlpool. If the discharge pipe were made of glass we could

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observe that more than floating objects were drawn down into the water. We could see small bubbles of air entrapped and carried by the water on its downward course. It requires no effort to imagine that if the water were allowed to drop through a fair height the bubbles would be reduced to one-half, one-quarter, one-eighth their original bulk, the final size depending on the depth of the fall of the water. Contrive to obtain this phenomenon on a large scale and one obtains a supply of compressed air which will continue as long as the required head of water exists.

A short account of how this is achieved practically will at once show both the simplicity and the cheapness of the method. At the outset it may be said that to make the installation of one of these compressor plants possible, a head of water must be available. It is matterless whether it be a high or a low one, the important point being that the flow be a good one. Upon the size of the head depends the horsepower developed in the plant. As near as possible to the head of water a shaft is sunk. The depth of this depends upon the pressure that the air delivered should possess. The shaft opens at its lower end into a large chamber while a second shaft leads up to the surface. The whole forms a kind of inverted syphon. Even in this initial stage, with only the excavation accomplished, some idea is obtained of how this contrivance is to act and provide a supply of air under pressure. Matters do not remain in this crude state. The shaft accommodates the compressor pipe (or pipes, should there happen to be more than one as is sometimes the case) of certain size. The space between the pipe and the shaft is concreted so as to render the lower chamber air tight. B is called the air chamber and except where it is hewn out of solid rock is concreted or grouted. This chamber or reservoir contains the lower portions of three pipes: (1) The Compressor Pipe, C, immediately below which is a conical shaped structure built of concrete and called the "disperser"—D; (2) the Blow-off Pipe—E; and (3) the Air Delivery Pipe or Air Main—M. Just what size these various pipes are to be depends upon the capacity of the plant.

The Compressor Pipe is carefully constructed at its upper end where it consists of two pipes, one telescoping into the other. To the inner, and movable, telescopic pipe is attached the Compressor Head—H. The principle of the head is shown in figure 2. A number of intake or suction pipes are screwed into the plate of the head which can be raised or lowered either by hand or automatically, thus preventing or permitting the water to flow down the shaft.

The plant is now sufficiently constructed to allow of an explanation of its working. The water is allowed to flow into the basin or Head Tank in which the Compressor Head is situated. Lowering the head admits the water to the intake pipes down which it pours, sucking in air with it. The captive bubbles are carried by the water down the pipe and during this downward course are subjected to an ever increasing pressure so that their size suffers a continual proportionate diminution. At the base of the shaft the disperser scatters the water in all directions in a broken form and the air bubbles are allowed to escape. They at once begin to fill the air chamber and by their accumulation they displace the water which escapes into the Tail Race T by way of the upward shaft U. The air will apparently collect in the reservoir until it fills this chamber and begins to escape up U; or perhaps it will work havoc by rushing up the compressor pipe and blowing off the head. Neither of these things happens, however, for any excess of air escapes off the blow-off pipe which acts as a safety valve. Should the air be stored up under a high pressure it blows out the water from the pipe with great force, producing an artificial geyser. In a plant of this type in Michigan the water is shot out to a height of over 100 feet. In the summer sunshine gorgeous rainbows are discovered in the spray. In the winter cold a huge iceberg is formed. From this it is seen that the capacity of the air chamber is the volume of air contained in it above the blow off water line. The air is drawn off as it is required and so long as air is being used there is no excess, that is, no blow off. In large plants part of the excess air is directed to the compressor head, which it raises, thus cutting off the water from the intake pipes. In this way the air is

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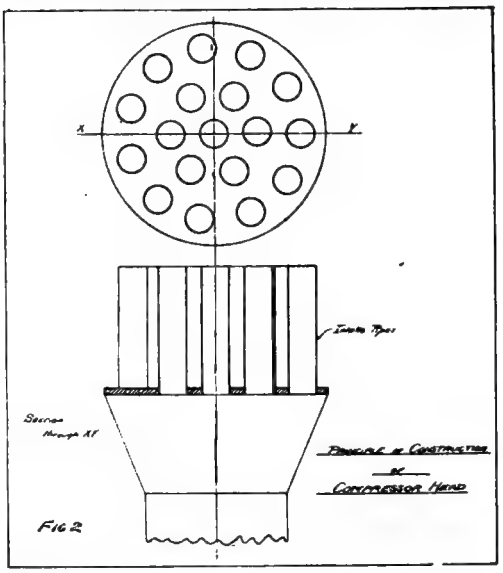
used to automatically stop the working of the compressor without depleting the store in the air chamber. As soon as the air is being used again the up-pressure on the head is released and it sinks below the water level again. Hence there is no stoppage at the points of consumption due to shortage of air. As long as air is being used the production of compressed air proceeds uniformly and continuously and at a constant pressure. This last fact is very important as all consumers of compressed air are aware and it is not a feature that one can depend upon in mechanical compressors. The hydraulic compressor delivers air at a never varying pressure which differs for different sized compressors. At the Cobalt plant, where the compressor has been in active operation for more than a year and supplies many of the mines in that part of Ontario with power for rock drills, the latest pressure records indicate a constant curve of 110 lbs. per square inch during the whole 24 hours of the day. The reason why no provision is made for storing the excess air which collects when the air delivery pipe is closed, is not far to seek. The process of production is a continual and rapid one. Besides this, it proceeds at a regular and invariable rate which is calculated to be in excess—if anything—of the rate of consumption, consequently there is always an available supply of air. The air chamber is constructed to act as a store house and is not a mere passage to the air main. To again refer to the Cobalt plant it may be said that the air chamber there is so huge that a stoppage at the compressor itself would not affect the supply of air to the consumers within 24 hours. Extra reservoirs or store houses for the excess of air are not required as each plant is so constructed as to be on the safe side of demands to be made upon it.

This means of compressing air is important and unique from another standpoint. *The air is compressed isothermally.* The water enters and leaves the plant at practically the same temperature. The air is compressed without change of temperature, or if any difference is to be found it is so slight when compared with the increase of temperature obtained in the ordinary way as to be negligible. The probability is that the air is at a slightly higher temperature to start with than the water, which fact increases rather than deteriorates from the value of this system. Again the pressure which the air undergoes condenses a portion of the water vapor, which it holds, so that the air delivered through the mains to the several points of consumption is *dryer than atmospheric air.* These facts speak loudly for the system that produces them. To accomplish this with a minimum of mechanical assistance which is absolutely devoid of moving parts excepting the telescoping action of the upper end of the compressor pipe—and to so construct the system that it regulates itself and requires a minimum of superintendence, is to have achieved an artistic master-



piece. A minimum quantity of machinery means a minimum of "wear and tear" and a minimum of expense. While experts at present opine that this system will never thoroughly replace the water turbines which are worked by high heads of water, all are agreed that for small heads possessing good volumes of water it is the only efficient and profitable method of air compression. In one case at least, this method has ousted electricity. "With the completion of the Hydraulic Air Plant Compressor the mines (at Cobalt) have forsaken electricity and are employing this new means of work, by which they are enabled to perform the same amount of work at one-third the previous cost." The first plant of this type to be installed delivered air to replace steam as a motive

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power. Summarily the distinctive features of this mode of air compression may be expressed as follows:

1. The air is compressed isothermally and consequently delivered in a drier state than when drawn from the atmosphere.
2. The air may be compressed to any extent depending on the vertical height of the uptake shaft.
3. Low falls of water can be economically utilized.
4. The system is simple and free from moving parts which is not the case with turbines.
5. "No other system of energy transmission can compare with this for economy of first cost and maintenance."

It is not necessary that the air should be used at the source of production. Like coal gas or natural gas it may be transmitted over a distance. The loss of energy due to pipe friction and leakage is very small. Though some engineers allow as much as 10 per cent. for losses due to these causes, yet over a distance of ten miles of 20-inch main, it has been calculated that an initial pressure of 120 lbs. drops to 112 lbs.—a loss of only 6.6 per cent. of available energy.

It is interesting to note that while this type of compressor is practically perfect in so many ways, there is a source of loss that is quite easily overlooked. The percentage of loss due to this cause is small, almost negligible, yet it is present. It is due to the buoyancy of the bubbles of air which are always tending to float to the surface again against the downward flow of the water. They can never actually do so as they would have to be exceedingly large—20 inches or so in diameter—before their buoyant force would react against a flow of water of, say, 6 feet per second, sufficiently to cause them to remain in a stationary position. As a matter of fact the bubbles must descend; nevertheless their buoyancy may react to an amount of as much as 1 per cent. Loss due to this cause is less as the shaft is deeper.

The force with which the water drags down the air or the "Frictional Effect" as it is called is always greater than the buoyancy of the air. The calculation of the exact percentage of loss that will result from this buoyant reaction is a nice piece of mathematics into which space forbids us to enter here. We can, however, enquire a little further into the relative volumes of the air at different points in its downward projection. If we consider the case of a single bubble we shall be able to observe its diminution under increasing pressures. The volume of a gas compressed isothermally varies inversely as the pressure, that is

$$\text{Volume} = \frac{\text{Atmospheric Pressure}}{\text{Absolute Pressure}}$$

where Absolute Pressure = Atmospheric Pressure plus the Gauge Pressure. Therefore:

$$\text{Volume} = \frac{\text{At. Pressure}}{\text{At. Pressure} + \text{Gauge Pressure}}$$

For instance, 5 lbs. gauge pressure = 19.7 lbs. Absolute Pressure.

10 lbs. gauge pressure = 24.7 lbs. Absolute pressure.

15 lbs. gauge pressure = 29.7 lbs. Absolute Pressure.

Hence the volume at any pressure is instantly obtained thus:

Table or Comparative Sizes and Volumes of a Bubble of Air Undergoing Hydraulic Compression.

Depth in feet	Comparative Sizes	Gauge Pressure in lbs.	Absolute Pressure in lbs.	Comparative Volume
0	◯	0	14.7	1.000
11.5	◯	5	19.7	.746
23	◯	10	24.7	.595
34.5	◯	15	29.7	.495
46	◯	20	34.7	.423
57.5	◯	25	39.7	.370
69	◯	30	44.7	.328
80.5	◯	35	49.7	.295
92	◯	40	54.7	.268
103.5	◯	45	59.7	.246
115.0	◯	50	64.7	.227
126.5	◯	55	69.7	.210
138.0	◯	60	74.7	.196
149.5	◯	65	79.7	.184

The depth in feet is easily calculated, for 27½ inches of water equals a pressure of 1 lb. It must be remembered that the "depth in feet" refers to the vertical height of water in the uptake shaft. 27½ inches = 2.3 ft. approximately. Therefore, the depth for any required pressure = 2.3 ft. + Gauge Pressure, namely 2.3 × 5 = 11.5 feet.

(*Continued on page 220*)

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High Frequency Current Apparatus

A Series of Articles Covering the Theory, Making and Operation of High Frequency, X-Ray and Ozone Apparatus.

By Frank Brewster

EDITOR'S NOTE:—In this series of articles the theory, construction and operation of X-Ray, High Frequency and Ozone equipments are covered at length. The working directions are exceedingly useful to all readers interested in constructing such apparatus and comprise not the least important part of this commendable series. There are nine chapters in all and every issue of MODERN ELECTRICS AND MECHANICS will contain a complete chapter. Although each instalment is complete in itself, it is highly important to read every chapter in order to secure the full value of the series.

CHAPTER I—THE INDUCTION COIL

FOR the excitation of X-ray tubes and numerous other electro-therapeutical applications, the induction coil has largely superseded the static machine for that purpose. The former embodies numerous commendable features that make it more desirable than the latter, which is at best uncertain in its action and incapable of producing the equivalent of the constant and powerful high-tension discharge given by the induction coil.

transforming action in the induction coil is based upon the phenomenon of electro-magnetic induction and can best be understood with the aid of a simple diagram as in Fig. 1. Referring to this diagram, we have an electric circuit P I B, traversed by an electric current emanating from the battery B or other source of electrical energy. At P is the heavy wire or primary coil of the induction coil I C; at I is represented a make-and-break device or circuit interrupter,

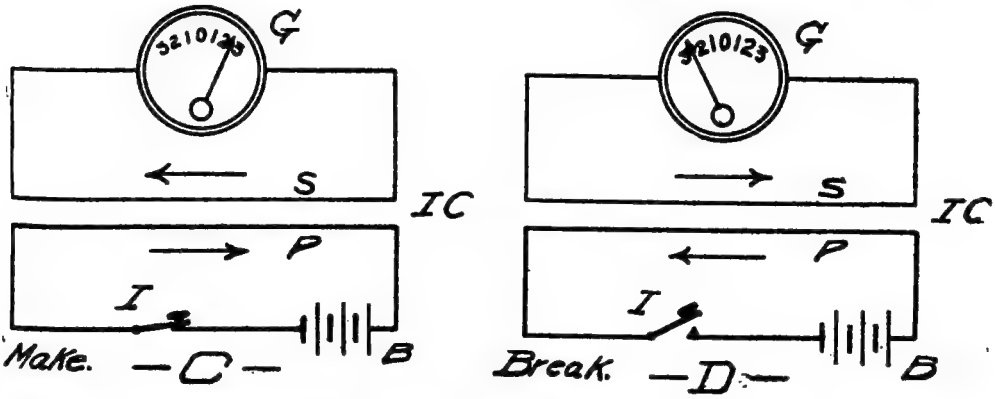

FIG. 1.—DIAGRAM SHOWING THE ACTION OF INDUCED CURRENTS BETWEEN TWO CONDUCTORS

The induction coil, as it is called, is nothing but an open core transformer, and exactly the same in principle as the regular commercial transformer employed in all of our modern electrical distributing systems for the purpose of transforming the high voltage current flowing over the distributing feed wires down to a lower one, suitable for lighting lamps and running motors. The underlying principle of the

serving to interrupt the current flowing in the coil P as well as in another or secondary coil S, this coil consisting of many turns of fine wire. A galvanometer or sensitive current gauge is indicated by G, the needle of the gauge deflecting from zero at the center, to the right or left, according to the direction or polarity of the current impressed upon it.

In this discussion, the current flowing

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in the primary circuit from the source of supply B is presumed to be a direct one, or one that travels always in the same direction, such as that produced by batteries or a direct-current dynamo. When the interrupting device is closed suddenly, position as in Fig. 1, the current surges through the primary circuit P I B, and causes to be set up about the primary coil a field of magnetic force of high intensity, which exists only while the current is changing or reaching its maximum value. The electro-magnetic field thus set up about the primary coil extends beyond it and threads through the convolutions of wire forming the secondary or fine wire coil, and in so doing induces a secondary current; this current flowing in an opposite direction to that of the primary current at "make."

"break" of the primary circuit is readily followed by noting the deflections of the galvanometer needles in diagram. The whole action is in accordance with Lenz's law, which states that the direction of the current produced by electro-magnetic induction is always such as to cause it to oppose the motion by which it was produced.

The secondary half-wave of current produced at the "break" of the primary circuit is the most powerful, and is one that does the work, wherever large induction coils with spark gaps or their equivalent are employed. In medical coils, where the secondary current has no gaps to jump, it consists of two half-waves of current; the first, that produced by the "make" of the primary circuit; the second, that occurring at the "break"

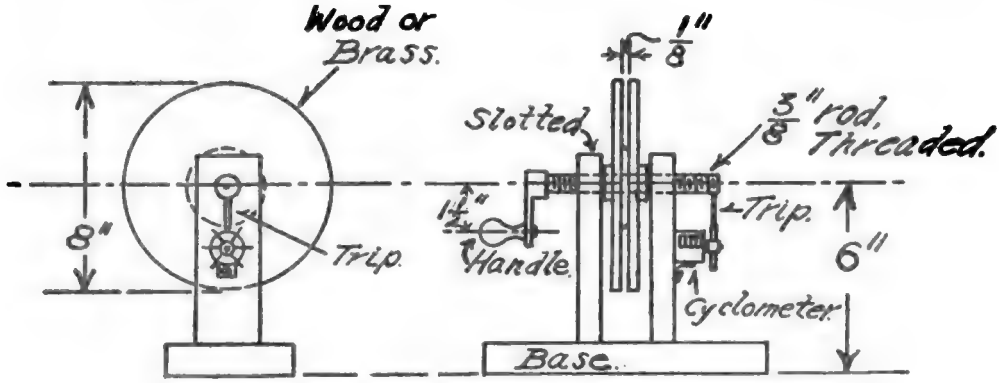

FIG. 2.—WORKING DRAWING FOR CONSTRUCTING A WINDING MACHINE FOR MAKING SECONDARY SECTIONS

This induced secondary current is termed the inverse one and is the weaker induced current. It is the one which is so undesirable in X-ray work, and some means is usually taken advantage of to suppress it as completely as possible.

When the interrupter I in the primary circuit is quickly opened—the quicker the more intense the results—there is produced a current of high value in the primary coil due to the reaction of the magnetic field upon it; the direction of this current being opposite to that of the one normally flowing in it from the battery. This self-induction or break current in the primary induces in the secondary a powerful current whose direction is opposite to it but the same as that of the "make" or normal primary current. This action at "make" and

of the primary circuit. It is thus seen that the ordinary medical coil delivers an unsymmetrical or distorted alternating current from an intermittent direct one in the primary winding.

In the case of a spark coil, such as those used in X-ray work, the secondary current becomes nearly unidirectional and less like an alternating or reversing one, owing to the fact that in this case the weaker or inverse half-wave produced cannot leap the gap, unless it be a small one, in which event the secondary current is again an oscillating one, swinging from the inverse or negative impulse to the positive impulse and back again many times a second. It is general practice to insert a high-tension rectifier or valve tube in the secondary circuit between the positive terminal and the anode or positive electrode of the X-ray

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bulb; the valve passing impulses in one direction only, and not those coming from the opposite direction, causing the tube to receive a nearly correct unipulsating current.

The potential or strength of the secondary current is dependent upon the ratio of the number of secondary turns or convolutions as compared to those in the primary coil; this relation being the same for regular alternating-current transformers. Thus, if there are 100 turns of wire in the primary coil and 50,000 in the secondary, the ratio of transformation, as it is called, is 50,000 divided by 100 or 500 to 1. If a current having a potential of 10 volts is passed through the primary coil, 500 times this number will emerge from the secondary winding or 5,000 volts, sufficient to jump a gap in common air about one-quarter of an inch long.

Induction coils of all sizes intended for sparking purposes are always equipped with a condenser shunted across the interrupter contacts, which absorbs the extra or self-induced current of the primary at break, otherwise the demagnetization of the iron core would be too sluggish. If the break of the interrupter can be made instantaneous, no condenser is required at all; also, the faster the speed of interruption, the smaller the condenser capacity may be, and vice versa. The apparent polarity of the secondary current can be ascertained by the use of the pole test-paper, or two pieces of fine iron wire may be attached to the secondary terminals; the piece connected to the positive terminal remaining cold, while the one attached to the negative pole will become very hot. Having reviewed briefly the action of the induction coil, we will now take up the details of constructing one capable of developing a 12-inch spark, suitable for most any X-ray work, and sufficiently powerful to excite large sized tubes. Such a coil can be built for far less money than the commercial product.

For a 12-inch coil of the type here described, the iron core will be considered first. It should be formed of the softest annealed iron wire obtainable, about No. 22 B.W.G.,* cut into straight lengths 18 inches long, and of sufficient quantity to form a round bundle 1⅝ inches in diameter. The weight of iron wire required is approximately 8 pounds, and costs 15 to 20 cents per pound. If there is any doubt as to the softness of the iron—quality cannot be overestimated—it should be re-annealed, the method below being a very good one. In a piece of iron pipe sufficiently large to accommodate the whole core, place all the core wire, screwing a cap on each end. Insert the pipe and core as it is, into the heart of a coal fire, allowing it to get just red hot, when it should be removed and immediately buried in the ashes under the grate, allowing it to cool slowly for several hours, the slower the better. When the core and pipe are thoroughly cold, the core may be removed from the pipe and bound with thread to hold it in shape. It can now be insulated by three or four layers of oiled linen (empire cloth) or heavy,

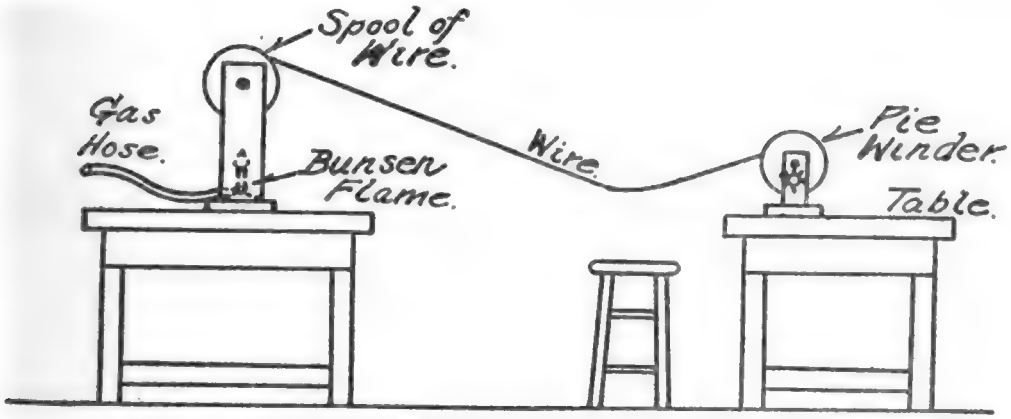

FIG. 3.—METHOD OF WINDING SECONDARY SECTIONS IN ORDER TO INSURE THE HIGHEST POSSIBLE INSULATION

* B.W.G. is Birmingham Wire Gauge.

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tough paper, shellacking well each layer.

The primary coil of heavy wire is wound over the insulated core and is composed of three layers of No. 10 B & S** gauge double cotton covered magnet wire, put on evenly and treating each

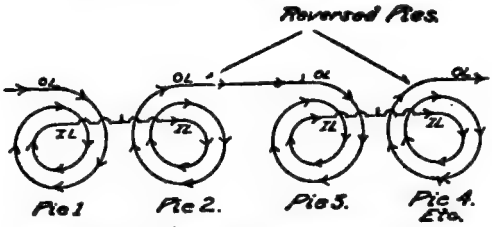

FIG. 4.—WIRING DIAGRAM, SHOWING THE CONNECTIONS FOR SECONDARY SECTIONS

layer with a coat of shellac, or the whole primary coil and core may be dipped in hot paraffine wax until thoroughly impregnated. A foot of wire should be left at each end of the completed coil to form leads for connecting.

The next part of the coil to receive attention is the insulating tube over the primary winding, which must possess sufficient electrical strength to keep the high tension secondary current from jumping through it into the primary. This tube is of the same length as the core, viz., 18 inches, with a wall ⅜ inch thick. The inside diameter is not given but must be just large enough to enable it to readily slip over the primary coil. The main object is to keep the secondary coil as close as possible to the primary, for oth-

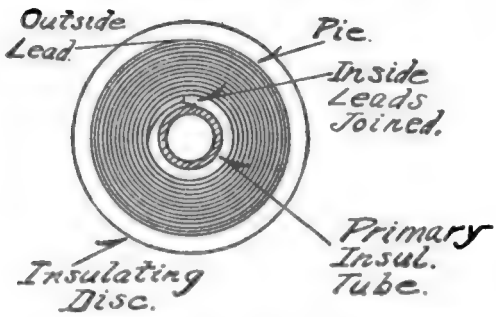

FIG. 4-A.—SECTIONAL VIEW OF A SECONDARY UNIT

erwise there is too great a magnetic loss between them. The tube itself is generally of hard-rubber or vulcanite, but glass forms a very excellent tube. Compressed mica compound or micanite glass and vulcanized fibre are common substitutes.

** Brown & Sharp.

Some makers build up their insulating tube out of several layers of empire cloth, but the thickness of the wall should be a little greater or ½ inch, instead of ⅜ inch as such a tube contains numerous air spaces, making it weaker than the solid tube. The oiled linen or empire cloth tube is mostly used for oil immersed coils, and here it is quite satisfactory as the oil can fill up the interstices between the layers.

The secondary coil of several thousand turns of fine wire is now to be prepared and for a 12-inch coil giving a fairly heavy spark, it can be made of 12 pounds

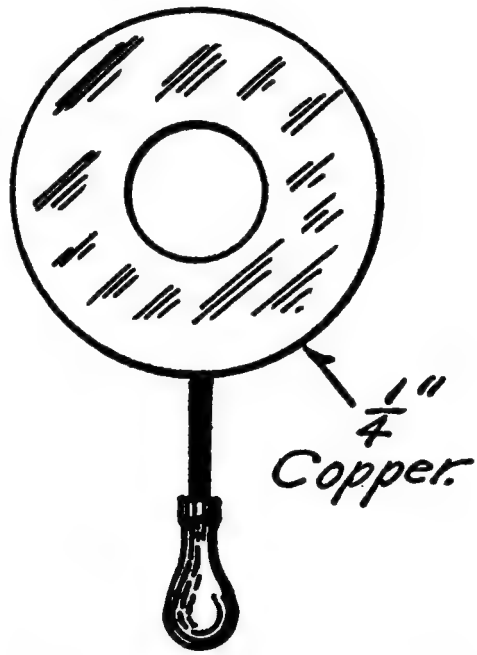

FIG. 5.—AN INVALUABLE TOOL FOR FINISHING THE SECONDARY OF A COIL

of No. 36 B. & S. single silk covered magnet wire. For a heavier spark use 15 pounds of No. 34 S. S. C. wire. The secondary winding has to stand a severe strain on account of the high voltage of the induced current, it being about 125,000 volts. The problem of sub-dividing this stress is best met by winding the wire in a number of thin sections or "pies" as they are commonly termed. Some of the best X-ray coils made are oil immersed, but on the other hand, the largest ones capable of delivering a spark

(*Continued on page 222*)

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Construction of Small Alternating Current Motors

Complete Working Instructions for the Building of Small Alternating Current Motors in Several Sizes

By Dr. A. E. Watson, E.E., Ph.D.

Illustrations from drawings made by the author.

EDITOR'S NOTE: This article marks the initial instalment of the series by Dr. A. E. Watson, covering the construction of alternating current motors in several sizes. This subject is one that has never appeared in the technical press before and should be of unusual interest to all the readers. The working directions are exceedingly clear and accompanied by drawings to illustrate every step in the work. An installment of the series will appear in every successive issue of MODERN ELECTRICS AND MECHANICS until the entire series has been covered.

THE "induction" electric motor combines both satisfaction and mystery. It is really one of the most remarkable machines ever invented, and perhaps will be of almost eternal utility. While the significance of the name may not be clear, the spectacle of a highly practical motor running without sliding contact of brushes on rings or commutator is truly delightful, and nothing short of a marvel. Omission of these parts reveals its most striking feature, but coupled to this, besides the saving in frictional losses and repairs, there is a very high working efficiency, good running conditions of speed and torque, and, in large sizes, the possibility of winding the machine directly for the moderate line voltages, therefore dispensing with the requirement of transformers.

No one machine, however, can be expected to combine all the possible good qualifications requisite for varied classes of work, and the induction motor is freely admitted to have its limitations. When operated on two-phase or three-phase alternating current circuits,—of which the latter is now the preferred,—the motor exhibits its best performance. Under the action of such progressively varying currents there is the effect of a rotating field magnetism, with the consequent dragging around of the rotor, but in case of supply of single-phase currents only, with a production of merely pulsating magnetism, the operation is less satisfactory. For a given power, greater weight and size are required, but the principal defect consists in a feeble starting torque. Indeed, were it not for auxiliary windings, it would have no starting qualities whatever. Yet over the working range the efficiency is as high as ordinarily realized with direct

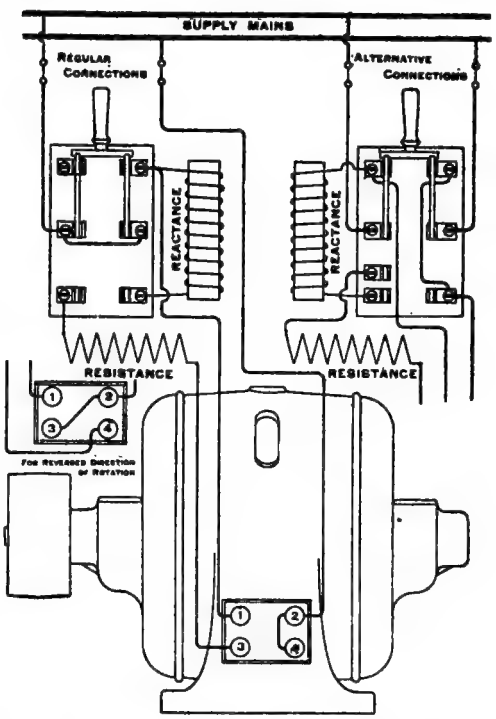

FIG. I.—DIAGRAM OF CONNECTIONS FOR ALTERNATING CURRENT MOTOR

current motors of equal power, though in consequence of high self-induction the current required is fictitiously large. In spite of these disabilities, single-phase currents are so common, in fact, the only sort available to many users, as to invite or compel the very extensive

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adoption of this "two-wire" motor. Though less desirable than the "polyphase," it is quite as easy to construct.

Experimenters are generally familiar with the principles of direct current machinery, but when the alternating are met, doubt and even despair is felt. To assist in the building of a motor of convenient and useful size, or at least to explain its essential construction, the drawings and text comprising this series have been prepared with unusual detail and explicitness. While even a few directions might suffice to encourage many an experimenter to essay the new construction, it is hoped that the completeness of these articles will be all the more welcomed. In his initial attempt, with only limited time and equipment, the builder is very properly seeking for advice and direction at almost every step. In the absence of a personal instructor, printed directions cannot greatly err in giving too detailed descriptions of procedure. Admission should be freely made, however, that several equally good methods of accomplishing the same results may often be found. Dependent upon the materials, tools, and preferences of the builder, there can be considerable latitude of methods. To recognize this important fact, there have been described two or more variations at almost every step in the design. The builder will, therefore, need to canvass the factors at stake to determine of which he can best avail himself.

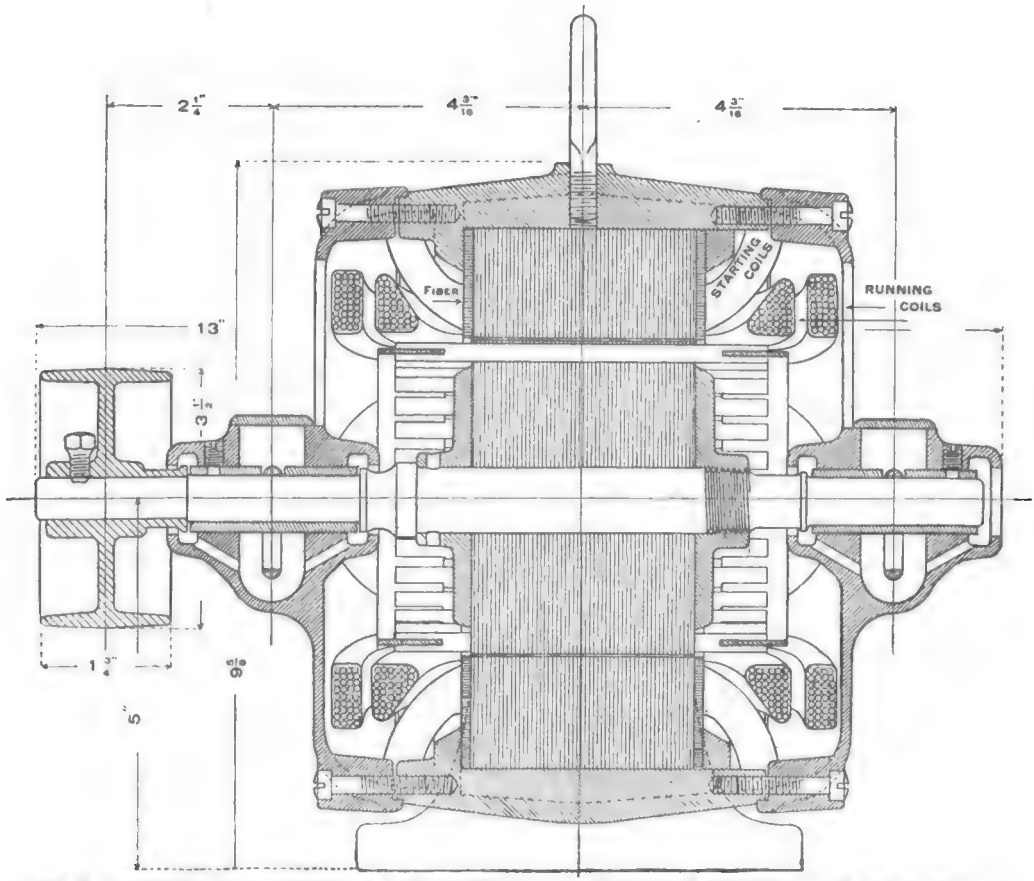

FIG. 2.—SECTIONAL VIEW THROUGH AN INDUCTION MOTOR, SHOWING WINDINGS AND MECHANICAL FEATURES

To make the scope of the series the more useful, it will not be limited to the case of the single-phase motor, for by certain logical extensions and additions, there can be embraced almost the entire range of alternating current machinery. With the design of the single-phase mo-

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tor first fully presented, there are only suitable changes to be made in the winding of the stationary member to adapt the machine for operation on two-phase or three-phase circuits, the rotating member being identical. With the stationary winding thus revised, a further change is offered in the use of a differently constructed rotor, having a definite winding terminating in collector rings, whereby, in connection with external resistances, a motor with very strong starting torque and variable speed characteristics may be realized. This new machine is also adapted for the unexpected experimental use as a "frequency-changer." A third rotor may be

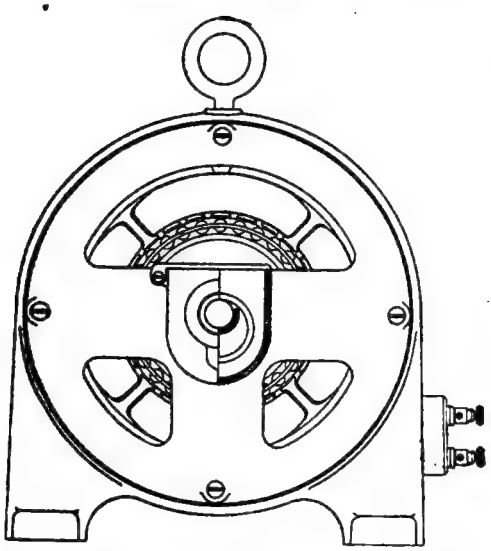

FIG. 3.—END VIEW OF INDUCTION MOTOR

provided that will at once adapt the machine to be used as a generator or a self-starting synchronous motor. Complete directions will be given for making all these constructions. While the particular dimensions are for machines of comparatively small size, they are as large as may meet the opportunity and use of a large number of readers; but the proportions are general, and will prove reliable for aiding in the design of machines both larger and smaller in size.

DEFINITION AND BEHAVIOR OF INDUCTION MOTORS

This type of motor derives its name from a certain analogy to the familiar induction coil. In such a transforming device there is a transfer of energy to the secondary coil by purely magnetic means. The direct current machine has an actual and visible electrical connection between field and armature windings, but in the alternating current motor there is induction rather than conduction. Whatever currents flow in the revolving member are induced then and there. Such a motor, free from commutator or even collector rings, would seem to be the nearest to perfection that could ever be conceived. For many applications this condition may be quite realized, and the operation regarded as ideal. For other uses, however, the motor may be unsuited, and the builder or purchaser should carefully enquire what such a motor will not do as well as what it will do. Three considerations of operation should be considered,—starting torque, efficiency, and speed control. Experience proves that only the direct current motor possesses all three in the desired degree. Two-phase and three-phase induction motors, when fitted with the simplest form of rotor, have only a moderate starting torque, but the efficiency is notably high; speed variation, however, with this form of rotor, is impractical. If definitely wound rotors with collector rings and brushes are to be tolerated, improved starting torque with lessened line current and variable speed are provided. The single-phase induction motor, unless fitted with special windings as already mentioned, is completely devoid of all starting torque and about three times the normal running current is required for even a feeble start. Curiously, the running current is nearly as much at no load as at full load, but this is in consequence of the lagging character of the current, for really the machine has a high efficiency, though of low and variable "power factor." There is absolutely no oportunity for speed variation. If the latter quality is imperative, some other type of motor, must be selected, say the "repulsion" or "series," should be selected.

If conditions of no load at time of starting can be secured, the device of temporarily providing current in certain auxiliary windings, always at slightly different instants of time from the main alternating currents, will suffice to give the rotor an initial start and to accel-

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erate it to near the "synchronous" speed. This winding can then be disconnected, and with the main winding alone the motor will carry its proper load. An explanation of the conditions can be derived from the analogy of a single crank mechanism, say foot-lathe or sewing machine. If such a device has stopped on the "dead-center," no amount of push or pull will start the rotation. If even a little assistance in a different direction is afforded, a start may be made, after which the rotation can readily be maintained from the action of the main crank. So with the single phase motor, however much current may be passed through the regular windings, even to the point of burning them, there would inherently be no tendency towards rotation. With some help by hand or otherwise, and other conditions being favorable, the motor is enabled to undertake its proper work. Hand starting is possible but inconvenient, though in addition to automatic devices, a pull by hand on the belt is of no small assistance. Self-starting by the electrical device of "splitting" the phase is frequently sufficient, and will be the method adopted in the motor described in this article.

EXPLANATION OF "SPLITTING" THE PHASE

Coils wound upon iron possess electrical "reactance," or self-induction, and this quality increases as the square of the number of turns comprising the coils. Reactance always produces a lagging of the current behind the electromotive force that drives the current. A purely "ohmic" resistance affects the amount of the current but does not introduce the lagging characteristic. In order to produce the requisite counter electromotive force that any motor must exert, the main winding must consist of a good many turns. This at once results in introducing the electromotive force of self-induction in addition to the motor counter electromotive force of rotation just mentioned. Even in a good motor this reactance may be quite as important a factor as the resistance, in which case the current would lag by as much as forty-five electrical "time" degrees. At the start, by temporarily putting in circuit additional reactance, the lag can be made still greater. If now, auxiliary coils consisting of only half as many turns be wound upon the same or neighboring iron, their reactance will be only one-quarter as much as that of the other coils, and the lag they permit would be considerably less; then by putting additional ohmic resistance in series with these coils, the lag would still further be reduced, and the current limited to some proper value. When two such circuits,—one having considerable reactance and small resistance, the other small reactance and considerable resistance,—are connected in parallel to the same transformer, alternating currents will flow in each, but at slightly different instants. At most, the real difference in "phase" may be only forty-five time degrees, but the result will be a magnetism that shifts along with the varying resultant strength of the currents.

In the actual "split-phase" motor the main windings occupy about two-thirds of the slots and consist of a certain number of turns all connected in series. The starting coils occupy the rest of the slots and interlink the main coils; they may consist of the same size of wire but in consequence of the reduced space of only half as many turns as in the main winding. To exert equal magnetizing force each set of coils should, of course, have the same number of ampere-turns, and if full load current is to be permitted to flow in the main windings, the starting coils should be arranged to receive twice as much current. Although this rapidly heats the wire, the condition is not injurious, for the circuit is in use for but a few moments. Ten seconds should suffice to start the motor; if thirty seconds do not suffice, more favorable conditions must be provided.

Wound in such a manner the motor is really a decrepit two-phase machine, but it would operate perfectly on a two-phase supply if one of the phases were supplied at half voltage. A genuine three-phase motor will be recognized as capable of operation on a single-phase supply, two of the circuits in series constituting the main winding and the third the starting winding. Indeed, it is common practice to install three-phase motors on single-phase circuits whenever there is the belief that possibly the service will ultimately be changed to the more desirable power conditions. For

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this reason, as well as for the particular case, this series will include a complete description of the "polyphase" windings. Further to assist single-phase starting conditions whatever be the winding of the stationary member, the pulley is sometimes fitted with a clutch between its hub and rim, so that until a reasonable speed has been attained, there is no movement of the machinery, but after centrifugal action has thrown out the pawls and engaged the rim, the belt starts with a jerk. A variation of construction is sometimes adopted by placing the clutch within the motor and permitting the revolving element at first to turn freely upon the shaft. If a really vigorous starting torque is required, the simple short-circuited form of rotor is not available, but there is required the more complicated form, consisting of core and a definite winding, quite like that of a direct current armature, but connected to collector rings, brushes, and external resistances. It is unfortunate, however, that just for the momentary conditions of starting, the wear and friction of all-day runs should thus be tolerated. This construction will, therefore, be deferred to the last portion of the series, the immediate subject being the description of the very simplest form. This will be by no means as easy to build as might be desired, and no false hopes should be held out that with a few tools and a little spare time a perfect machine will be produced.

The machine to be described is not a toy, but supposedly of good appearance, of faultless mechanical design, capable of long life at continuous and economical service on regular electric lighting circuits. Machines have already been constructed by the author, and their operation verified. While experience gained in the making of direct current machinery will be of assistance to the builder, many of the lessons will be in the nature of comparison and difference rather than in similarity. The requirement of sheet iron, and in somewhat difficult shape, rather than easily procured cast iron or forgings, presents the first difficulty, and the small clearance between revolving and stationary members the second. The winding of the stationary member is rather tedious, for the wire is to be placed in position, turn upon turn, by hand, to fill internal slots. Access to good machine tools will be necessary, but the completeness with which manual training schools are now equipped and the extent of individual ownership make possible the building of electrical and other machinery by a rapidly increasing number of students and amateurs.

The two essential parts of an induction motor are variously named. Following the direct current analogy, one might be denoted as the field and the other as the armature. To a considerable degree, these names are sufficient. If, however, the machine is to be used as a generator, the stationary part becomes the armature, so it is awkward to call a certain structure part of the time a field magnet and at another time an armature. To follow out the inherent transformer analogy, the stationary member can be denoted as the primary and the rotating member the secondary. A third designation may be based on purely mechanical grounds, one part being the stator and the other the rotor. These names,—certainly distinctive and perhaps the most acceptable,—will be the ones here adopted.

(*To be continued in March Issue*)

WIRELESS ASSOCIATION OF LANCASTER

The Wireless Association of Lancaster was organized on June 3, 1913. At the present time the officers of this association are as follows: Vernon Groff, president; Howard Worrest, vice-president; Richard Barr, treasurer; Wilford H. McClellan, secretary, and Coral Shriner, operator and inspector. All communications should be addressed to the secretary.

THE SUSPENSION OF A RADIO OPERATOR

The Department of Commerce recently suspended for a period of thirty days the license of a radio operator who had been found asleep at his post three times during the voyage of the steamer. This incident serves to indicate that every precaution is being taken by the department to insure the strictest vigilance on the part of those that operate the wireless sets of steamers.

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Recent Electric Lamp Improvements

By Dr. Leonard Keene Hirshberg.

A.B., M.A., M.D. (Johns Hopkins)

THE tungsten lamp has been lately improved in so many respects that it may now be safely exposed to shocks and used under conditions of continued vibration without suffering thereby in efficiency. Even the nitrogen vapor tungsten bulb, although discovered only a month or two ago, is already out of date besides many other new discoveries. All of the supposed advantages of the old carbon filament incandescent lamp have now disappeared with the new discoveries.

Of the two plans for making tough tungsten—also tantalum and molybdenum—filaments, one consists of the production of long continuous lengths of tungsten wire, which is, of course, first obtained in the form of a fine powder. Short rods are made from this tungsten powder and heated until the dust fuses together. Proper mechanical treatment while these rods are warm, if continued long enough, makes ductile and flexible tungsten wire easily run through dies.

This is a vast improvement upon the old method of producing the filaments by squirting the tungsten under pressure to make a brittle hairpin. The other plan is the outcome of the discovery that many highly fusible substances can be added to tungsten successfully to change the whole character of the tungsten filament. The result is a wire as flexible as silk and as tough as steel. It can be wound around the finger, while weights of a half-pound and more may be easily suspended from it without injury to the tungsten. Trolley cars and trains may now be equipped with tungsten lamps and even collide with one another without breaking them.

Tungsten lamps with the neon gas is the latest incandescent light in Germany. This gas, as the reader probably knows, is present in the air in the proportion of one volume to every seventy thousand volumes of the atmosphere.

Neon is easily separated from the other gases of the air by the method used in connection with making liquid air. It is a far better conductor of electricity than oxygen or nitrogen. Neon tubes sixty-five millimeters in diameter have been made in lengths up to six or ten meters—about eleven yards. These give a light of 450 candlepower to each yard or meter of length. The efficiency is about half a watt per candlepower. The voltage is in proportion to the length of the tube and is something like one thousand volts. The life of a neon filled lamp is about one hundred hours, after which the lamps can be again used by filling them with neon. An automatic valve is arranged on these neon-tungsten lamps—the tungsten need not be present at all in the tubes—which admits neon gas from a tank as soon as the pressure falls.

Each household can purchase tanks of neon just as they do carbonated water tanks. Thus, you may refill your own lamp whenever you so desire. The light from neon bulbs is rich in red rays and is in a way comparable to an open grate fire. It has the same sort of effect on colors as the yellow flame arcs. It is not destructive because of the paucity of ultra-violet rays.

The neon lamp cannot as yet be used on low pressures of 220 volts, but in Paris where the lamp has left the laboratories for practical commercial use, experiments are being carried out in an attempt to solve the high voltage problem.

THE HUB CITY RADIO ASSOCIATION

At a recent meeting of the wireless amateurs in Jefferson City, Mo., the Hub City Radio Association was organized, and the following officers elected: Alex. Hope, president; Willis Corwin, secretary;; Frederick Binder, treasurer, and Theodore Schott, sergeant-at-arms.

This club will be pleased to communicate with other wireless clubs, and all communications should be addressed to the secretary at 117 East McCarty street, Jefferson City, Mo. The club will also be glad to receive messages from any amateurs within range, the general call of the organization being HCR.

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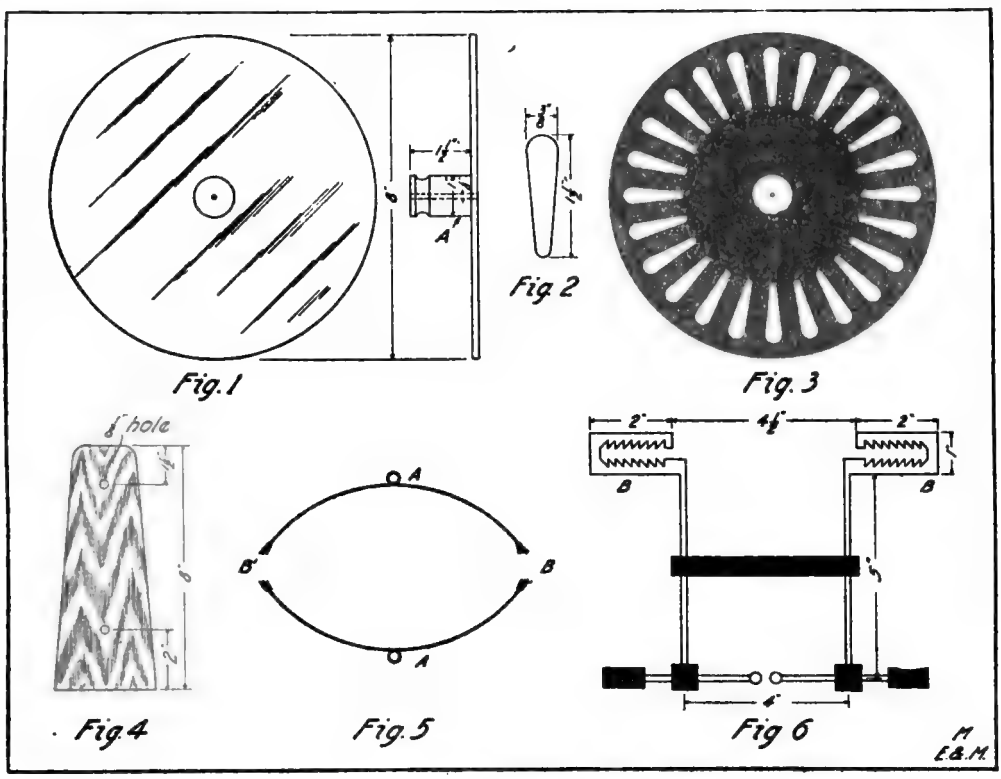
Experimental Department

This department is maintained for the purpose of encouraging the experimenter to develop new ideas. Every reader is welcome to contribute to this department. Contributions should be written on one side of the paper only, using as many sheets as are necessary. Typewritten contributions employing double spacing are preferable. Good sketches are not necessary, as our art department can work up rough sketches that are clear enough to illustrate the idea. Sketches must be made on separate sheets from those containing the description. Return postage must be enclosed if return of unused manuscript is desired.

Three prizes of Five, Two and One-Half Dollars and One Dollar are awarded for the three best ideas published each month. Other contributions are paid for at space rates.

FIRST PRIZE
A SMALL STATIC MACHINE

The static machine shown in the accompanying illustrations is capable of producing a 3-inch spark.



Procure two glass plates eight inches square and cut them into circles having a diameter of eight inches. In the exact center of each bore a ⅛-inch hole. This may be done with a small drill that has been moistened with turpentine. Dry the plates thoroughly after the work has been done, and shellac. When dry, divide the circle into twenty-four equal segments, marking all the divisions. Shellac the plates over again and allow to dry.

In the meantime prepare 48 small pieces of zinc or tinfoil and cut into the shape shown in Fig. 2. Zinc foil is preferred to the latter, but if it cannot be procured, tinfoil will answer the purpose. The dimensions indicated in Fig. 2 should be followed carefully in making the small pieces.

When the plates are perfectly dry give them another coat of shellac, and on the previously made marks stick the pieces that have been cut with the nar-

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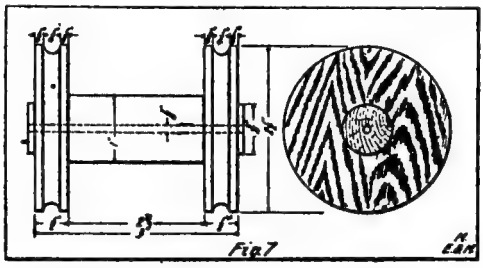
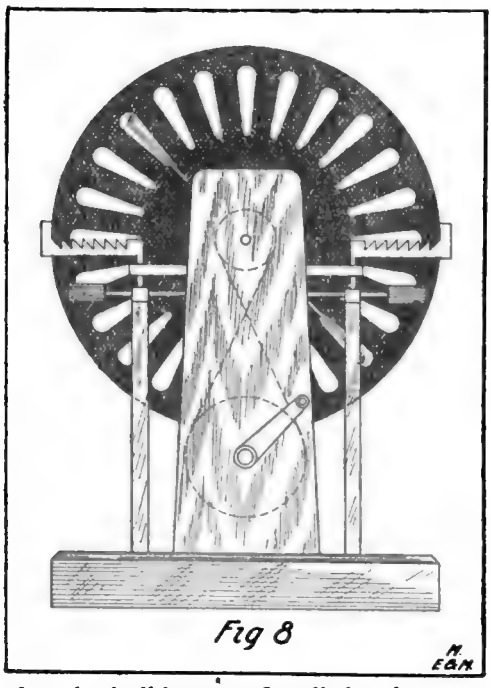
rowest end towards the center of the plate, as indicated in Fig. 3.

The next step is to turn from wood two small pulleys measuring one inch in diameter and one and one-half inches in length. With extra thick shellac stick these pieces on the plates over the holes



that have been bored in the center, as shown in Fig. 1. The most difficult part of the work has now been completed.

The stand is made from well-seasoned and thoroughly dried hard wood. Cut two pieces as shown in Fig. 4. The base of the machine may be made of any size



that the builder sees fit, all that is necessary is that it should hold the two upright pieces shown in Fig. 4.

The next parts to be made are the two neutralizers, which should be constructed from brass wire of about No. 15 gauge, or larger, bent as shown at A. Fig. 5. Small brass tinsel can be soldered on the ends so as to protect the tinfoil segments as shown at B and B^1. Screws are passed through the loops shown at A, thus fastening the neutralizers to the standards.

The remaining parts consist of the collectors and pulley. The former may be made of the same kind of wire as the neutralizers. Referring to Fig. 6, A^1, A^2, and A^3, are made of vulcanized rubber, while the remaining parts are made of brass. A screw passes through the vulcanized rubber part, A^1, at I, and fastens the collector to the frame, the glass plates revolving through the teeth shown at B. The parts containing the teeth may be made from sheet brass cut in the form indicated and soldered to the wire parts.

A small crank fits into a hole made in the standard and its shaft extends through the hole bored into the combined wooden pulley shown in Fig. 7. The shaft should fit the pulley tightly.

Two belts are required from the larger pulleys to the smaller ones that are mounted on the glass plates. One belt should be twisted one-half turn so as to reverse the rotation of one plate as compared to the other. This will cause the plates to turn in opposite directions. The plates are held in place by a ⅛-inch steel shaft indicated at A, Fig. 8.

If the directions are carefully followed, a very successful static machine will be the result. Experiments will show the relative position of the neutralizers and oscillator. If at any time the machine fails to generate, dust thoroughly and warm it near a fire.

Contributed by *Moore Stuart.*

SECOND PRIZE

A ROTARY "CHOPPED" SPARK GAP

I submit herewith a description of a discharger of unique design, which I have termed a "rotary chopped spark gap." The construction of this instrument is much simpler than that of an ordinary rotary gap, and while its operation is quite similar, a somewhat different note is produced.

As may be seen from the accompanying drawing, the instrument consists simply of a thick insulating disc rotated between the electrodes of a common ad-

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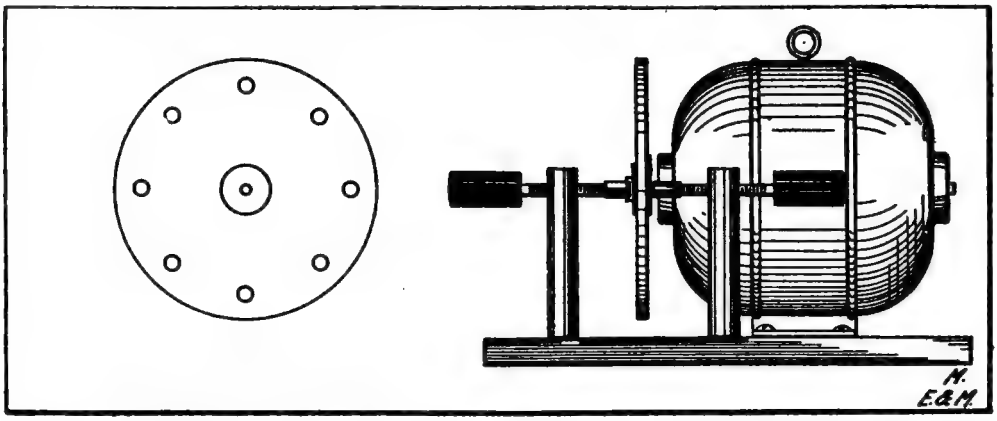
justable spark gap. This insulating disc may be cut either from asbestos board, or from a sheet of fiber impregnated with some non-combustible insulating varnish. About eight holes the size of



the electrodes should be drilled near the periphery, as shown. Other dimensions are immaterial. This rotor may be mounted in any convenient manner, on the shaft of a small motor. It is clear that when the disc is revolved the spark will be interrupted in just the same manner as with an ordinary rotary gap, but the result is accomplished in a much simpler manner.

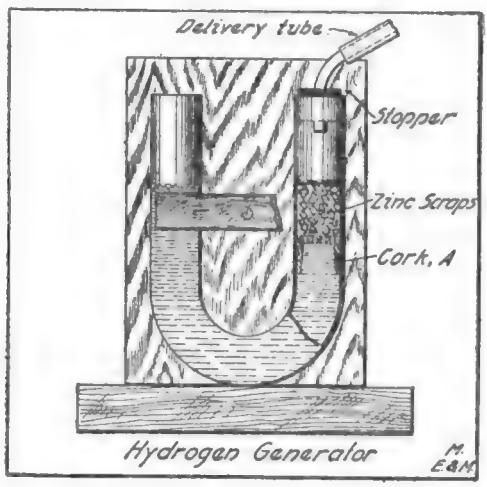
Contributed by *F. J. Watts.*

THIRD PRIZE

HYDROGEN GENERATOR

I have here described the construction of a simple apparatus for the continuous production of hydrogen. This gas is required in a great many chemical experiments, and is also valuable in increasing the efficiency of the d.c. arc used for the production of undamped oscillations in wireless work.

This generator consists, essentially, of glass U tube mounted in an upright position; some zinc scrap, and a delivery tube being placed in one leg, and a small quantity of dilute sulphuric acid in the other. Referring to the drawing, a paraffined cork A, cut the form indicated, is tightly fitted into the lower part of one leg of the U. This cork serves the purpose of supporting the zinc scraps, but must be perforated to allow the acid to pass through. This perforating should be done before paraffining, care being taken to see that the holes remain unobstructed. It will be seen that the delivery tube is taken in through a stopper at the mouth of the leg. This stopper should fit tightly in order to make this end of the U substantially airtight. After having placed some zinc scrap over the perforated cork, and fitted the stopper, pour in a 10 per cent. solution of sulphuric acid until about an inch of the zinc is covered. The acid at once attacks the metal and hydrogen will result. This gas may be led away through the delivery tube. In operation the production of gas will continue until a certain amount is accumulated, when the increase of pressure will serve to drive the acid up the opposite leg and away from the zinc. If properly balanced this device will be automatic in operation, and should produce a supply of gas practically corresponding to the demand.



The same principle may be applied with equal success to the production of

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acetylene gas; in this case carbide being substituted for zinc, and ordinary water for the acid.

Contributed by *Thos. W. Benson.*

AN AUDION STORAGE BATTERY

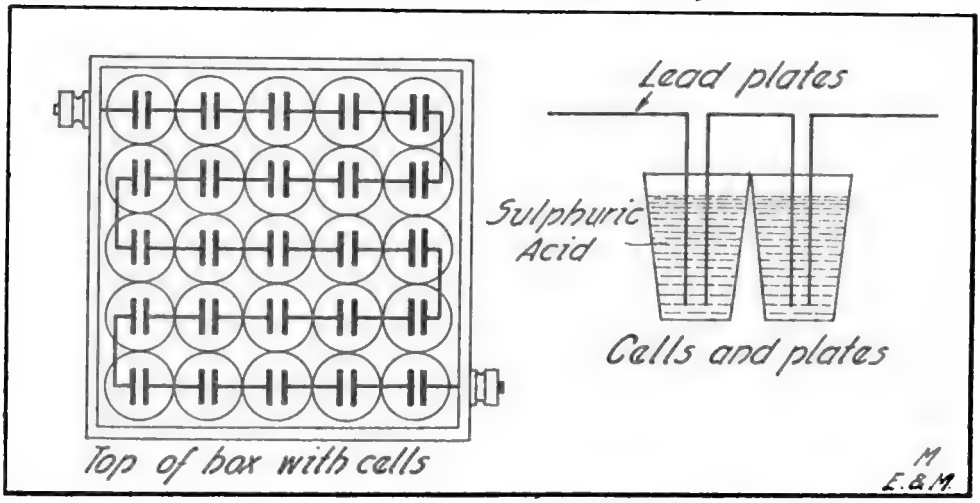
The following description of a small storage battery will be of especial interest to wireless experimenters employing an audion, but there are also many laboratory uses to which such an outfit may be put.

The amount of current required in the detecting circuit of an audion is very small, and an extremely simple battery will therefore serve the purpose. In the accompanying figures is illustrated a battery suited to this service. It will be seen to consist of 20 glass receptacles filled with dilute sulphuric acid, in which strips of lead are placed. These receptacles need be no larger than very small jelly tumblers. They are placed in a shallow box, in the bottom of which baking soda should be sprinkled in order to neutralize any acid that may spill over. The plates may be cut from common 1/16-inch tinsmith's sheet lead. They should be as wide as possible, and may be connected together in any convenient way. The electrolyte is a 10 per cent. solution of sulphuric acid. This battery may be charged either direct from d.c. lighting current, or with the aid of a rectifier on a.c. In any case the charging current should be kept down to about ⅛ ampere by means of a suitable resistance. Before the battery will be available for use, it is necessary to "form" the plates by passing the normal charging current through them for a considerable period of time, say 15 or 20 hours.

After this operation care should be taken that the cells are always charged with current flowing through them in the same direction as in the original "forming" process.

This battery will be available only for purposes involving the use of a very small amount of current, although if connected in multiple it might be used to light a miniature lamp. The voltage produced will depend upon the completeness of the forming operation, and will vary between 1 and 2 volts per cell.

Contributed by *H. Erben.*



CONVERTING MAGNETO GENERATOR INTO MOTOR

No doubt there are many experimenters who possess an old telephone magneto which is of no practical use to them. The accompanying drawing illustrates a method of converting such a machine into a small d.c. motor. The first operation in accomplishing this result is to disassemble the generator, and unwind the armature wire. A commutator may be conveniently made in the manner shown in the drawing. Two segments are cut to the shape indicated out of sheet brass or copper, and soldered on; one of them to the insulated pin, and the other to the outer portion of the shaft. The armature should be rewound with wire of from 20 to 24 gauge, care being taken to wind the two halves in opposite directions in order to secure correct

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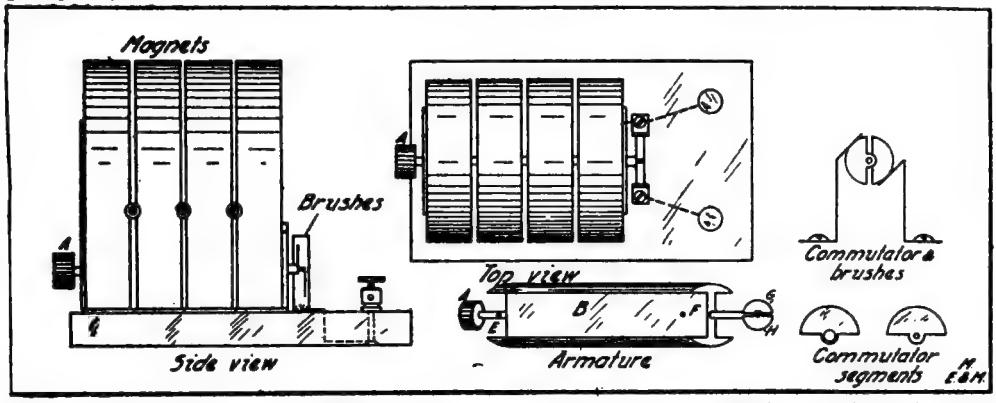
magnetic polarity. The machine may now be reassembled and mounted on a suitable base. Brushes can be made of spring copper bent to the form indicated in the sketch and screwed down to the base. Their "angle of lead" should be carefully adjusted, while the machine is running, until maximum efficiency is obtained. The voltage required to operate this motor at full speed will vary with the gauge and exact quantity wire wound on the armature, but the proper potential may readily be determined by experiment.

Contributed by *S. G. Ryder.*

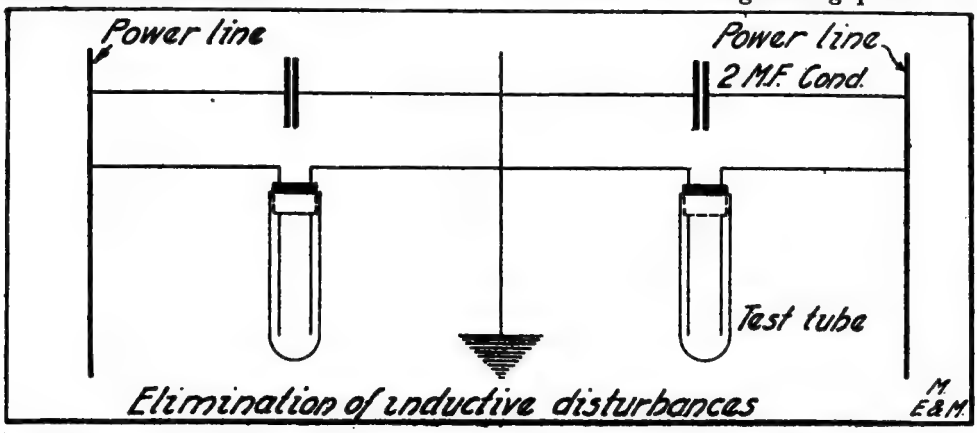


"KICK-BACK" PREVENTION

Many amateurs experience a great deal of trouble with their transmitting sets, resulting from a phenomenon generally known as "kick-back," the most common manifestations of which are blown fuses, burned out meters, and sparking in the electric light fixtures.

A friend of mine experiencing this difficulty with a ½-kw. set, burned out three of the lighting company's meters before the matter was remedied. The usual 2 m.f. condensers placed across the wireless primary leads proved ineffectual, as did also the installation of a special pole transformer. At a loss for a solution of the difficulty, it at last occurred to my friend that the trouble might possibly be due to induction, instead of to the usually ascribed "kick-back." A test revealed the fact that a potential of 50,000 volts was being set up in the line from which power for the wireless set was being secured, although the aerial was 90 feet away, and ran parallel to the power circuit for a distance of only 15 feet. A change in the position of the line resulted in the entire elimination of the disturbance, even the primary condenser becoming unnecessary.

I have experienced these same difficulties, but as it was impracticable for me to have the neighboring power line moved, I solved the problem by placing a pair of electrolytic lightning arresters across the house supply leads. These were made by placing two aluminum wires in a test tube filled with sodium phosphate. When these froze in win-



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ter, I replaced them with 2 m.f. condensers, which ended the trouble.

I believe that many of the troubles of the amateur usually classified under "kick-back," are due rather to induction between the aerial and power line. As indicated above, this trouble may readily be eliminated, either by altering the relative position of the antenna and line, or by the use of some "kick-back" device on the outside power circuit.

Contributed by *D. T. Stetson.*

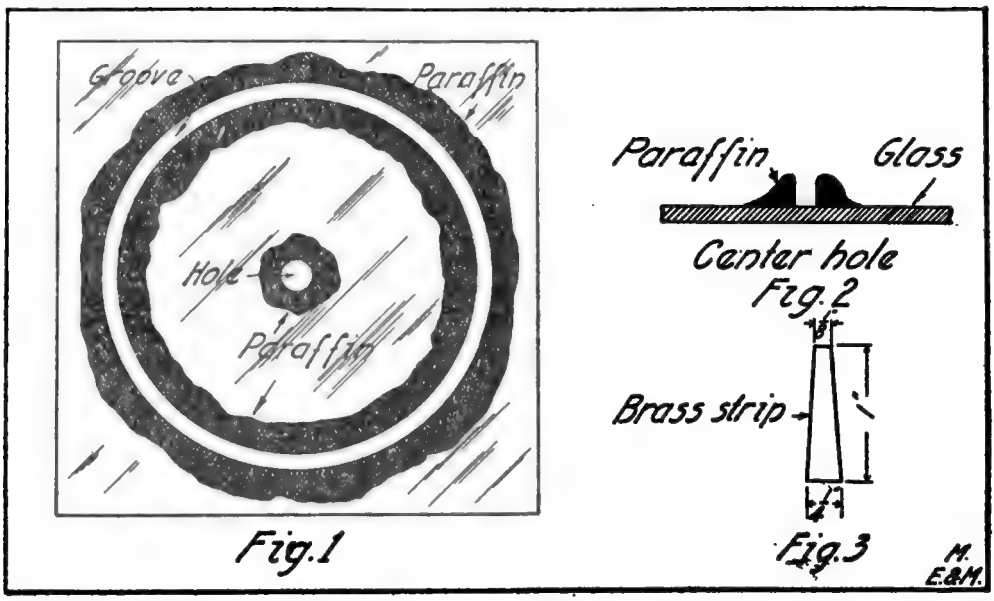
MAKING STATIC MACHINE PLATES

Cutting round glass plates for a static machine is simple if done in the right way. The materials needed are hydrofluoric acid or "diamond ink," paraffin, and a small brass strip. The dimensions given in this article are for glass plates measuring 14 by 14 inches.

Take one plate and mark the center, then draw a circle 12 inches in diameter. On the circle pour the melted paraffin, extending it one-half inch on each side of the line. Then fasten the brass strip shown in Fig. 3 on the compass and make a groove in the paraffin by adjusting the compass ends six inches apart, placing the end without the groover in the center and drawing a circle. Then pour the acid in the groove as shown in Fig. 1.

Around the center build a cup or crater, as indicated in Fig. 2, of paraffin and scratch away the material to the desired width of the hole. Then pour in the acid. This should be done in a strong breeze, and be sure the wind blows the fumes away from the face as they are dangerous.

Contributed by *George Danjunas.*



A CAUTION ABOUT ELECTROLYTIC INTERRUPTERS

In the December, 1913, issue of your magazine appeared an article by David Kuskin, on the construction of an electrolytic interrupter. I made one of these instruments, and it worked fine for about ten minutes, when it exploded, throwing the solution on one side of my face and cutting my father's ear with a piece of flying glass.

I think that by having the solution in the jar come up even with that in the bulb this accident would not have happened. I thought that you might like to know of this experience in order that others might be warned against a similar disaster.

Contributed by *Jack Fessenden.*

A SYNCHRONOUS GAP FOR SPARK COILS

The diagrams accompanying this article are self-explanatory, but a few remarks will aid to make them more comprehensive.

The armature should be of spring brass and as light as possible. An iron

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strip is mounted on the under side as shown. The magnets are wound with

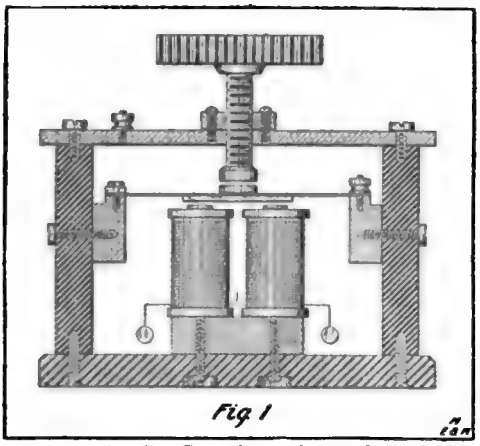


Fig. 1

No. 14 S. C. C. wire, three layers being sufficient. The dimensions are left to the judgment of the builder. The gap should be as short as possible. The function of the gap is as follows: When the key is depressed the armature is drawn down, widening the gap and allowing the condenser to charge to the full potential. When the interrupter on

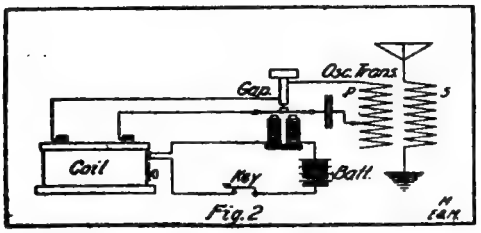


Fig. 2

the coil breaks the circuit the armature on the gap flies back allowing the condenser to discharge with very little resistance in the gap. It can be clearly seen that the gap is always in synchronism with the interruptions of the coil.

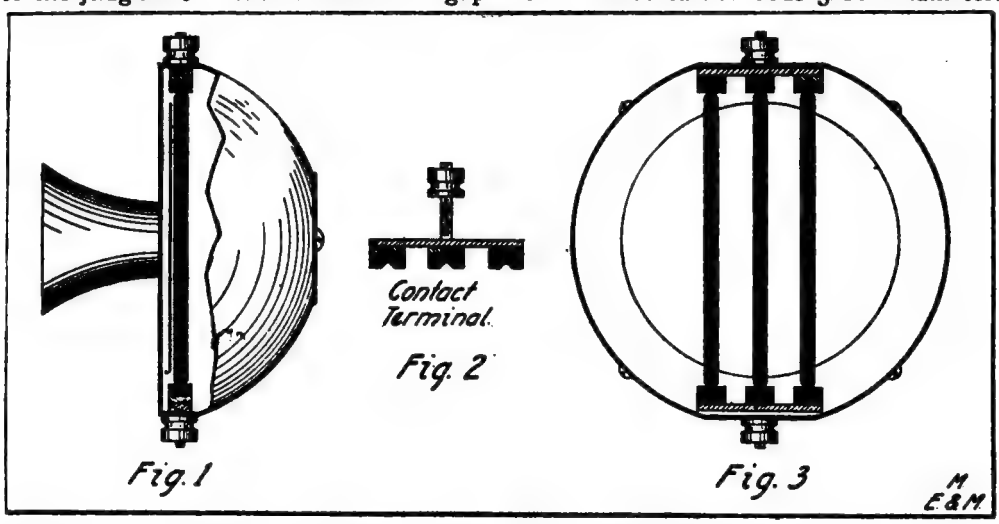
The above gap used on a 1-inch coil not only increased the range to a great extent, but the tone was exceedingly clear.

Contributed by *Anthony Hagen.*

A SENSITIVE MICROPHONE

The following is a description of a sensitive microphone. By observing the illustrations closely one can clearly understand the principles involved. The parts used in constructing it are as follows:

BC—Six tops of flashlight battery carbons.
BP—Two binding posts.
CC—Two contact carbons.
CR—Three carbon rods 3/16" diameter.



MD—Mica diaphragm.
MP—Mouthpiece.
TS—Transmitter shell.

The contact terminals are composed of binding posts and three flashlight battery carbon tops, BC, with a small hole drilled in the center of each to let carbon rod CR fit in. The binding post and battery carbon tops are soldered on copper strip as shown in Fig. 2.

After properly adjusting the microphone, connect it in circuit with a number of flashlight batteries and a 75-ohm receiver. Place the microphone in a room where several persons are holding a conversation. With the receiver in another room any one can hear the voices very plainly. The transmitter will

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stand a moderately strong current without injury.

It would perhaps be a good plan for the wireless experimenter to try it on his wireless phone.

Contributed by *H. R. Harris.*

CONSTRUCTION OF A SIMPLE DENTAL LAMP

The following is a description of a simple extension lamp which may be used on any pocket flashlight. I have found it to be very convenient and handy in inspecting teeth.

The only materials necessary can be found in almost any scrap box of the amateur mechanic. About six inches of No. 12 double-covered wire, such as is used for house wiring and having an inner cover of rubber and an outer cover of braid, should first be procured. Next, obtain the base of a burned-out miniature lamp, one small brass screw, a piece of thick walled rubber or fibre tube about one-half inch in diameter and three-quarter inch long, remove from a miniature receptacle the threaded bushing under which the lamp is screwed as well as a mica washer found in the bottom of same and also procure about one foot of a small sized magnet wire of about No. 28 or 30.

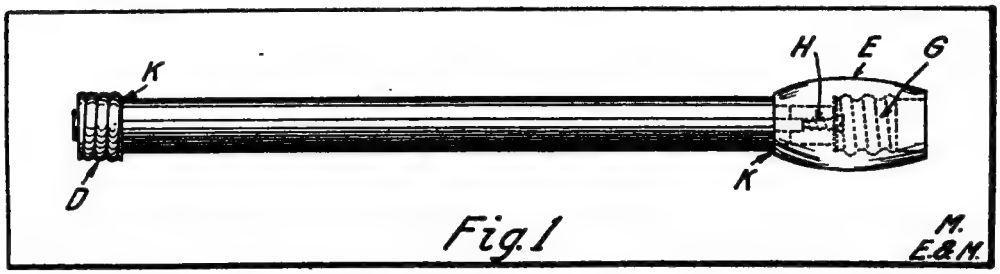

Fig. 1

For assembling refer to sketches Figs. 1 and 2. The procedure is as follows: First, take the fibre tube E and round off edges and ream hole two-thirds way to take the bushing G. Now take the No. 12 wire and scrape off insulation about one-half inch on each end and run the magnet wire in between the two coverings, B and C. Next, solder end of wire A to screw H, after it has been inserted through washer, I, then put in place in bushing G. Also solder end of magnet wire F to side of bushing G. It is now ready to insert in the large end of the hole reamed in the fibre tube. Take the base of a miniature lamp D and solder end of wire J to center and remaining end of magnet wire L to the outer part. Fill the spaces around wire K with sealing wax.

Extension lamp is then ready for use.

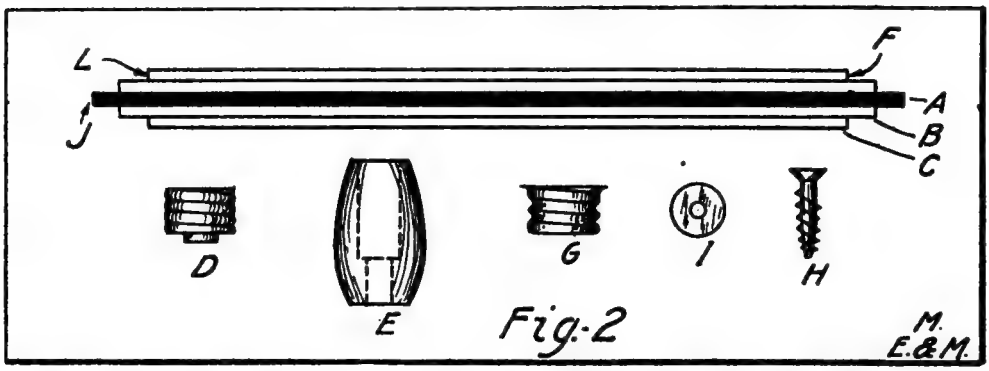

Fig. 2

It can be employed by removing the lamp from a pocket flashlight and inserting plug D in its place. The lamp from the flashlight is screwed in G and the flexible light can then be used for reaching any part of the mouth or throat.

Contributed by

Chester L. Pratt.

One of the latest automobile accessories is a Red Cross sign made of glass which can be illuminated from within by an incandescent lamp. It is used for physicians' automobiles and hospital ambulances.

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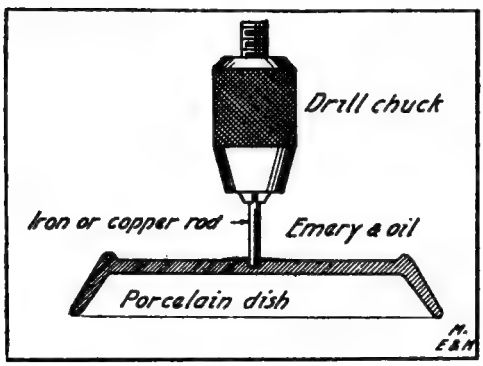
Practical Hints

This department is devoted to contributions that deal with new tools, machinery, methods of simplifying different tasks and other similar subjects of interest to the electrician and mechanic in particular, and everyone in general. Contributions to this department should not exceed 200 words. A rough sketch is desirous in instances where the idea will be rendered more comprehensible by its use. All contributions will be paid for at regular space rates on publication.

DISH BASES AND THE CUTTING OF PORCELAIN

A very simple, and certainly effective method of providing insulating bases for wireless instruments, lies in the use of porcelain dishes or plates. These may



be secured in a large variety of sizes and shapes, and when fitted up, do not appear particularly incongruous. Holes may quite readily be made through porcelain by using as a drill a flat-ended copper or iron rod a little smaller than the desired perforation, and feeding this with emery and oil as indicated in the accompanying sketch. Plates may be sawed up in a like manner by using a thin iron disc fed with this emery in oil, and rotated at a speed of four or five hundred r.p.m. This process would doubtless prove similarly effective in cutting-off in the lathe. In this case use a soft, blunt tool fed as above directed.

Contributed by *John W. Gledhill.*

A BLUE PRINT INTENSIFIER

In making blue prints it is always desirable to have a dark blue print, but at the same time it is necessary that all the fine lines and small letters and figures are easily readable.

This is often difficult and to secure this result the writer has used the following method with great success:

The prints were exposed somewhat longer than ordinarily and were then toned in a weak solution of potassium bichromate.

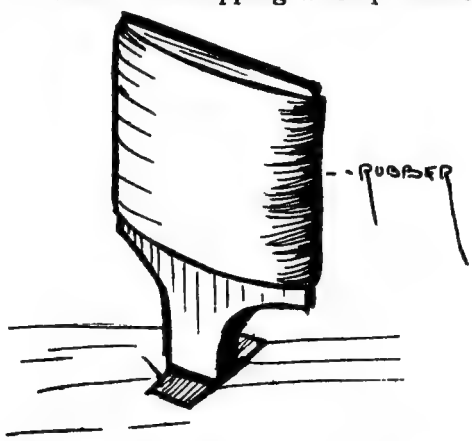
A large crystal of the bichromate was kept in a bit of cloth and this was allowed to soak in the developing or washing tank until the water had assumed the characteristic yellow color of the salt and in this the prints were washed.

A fresh solution was made every few days.

Contributed by *L. C. Horle.*

INEXPENSIVE NON-SLIP FOOT BREAK COVERING

A practical and inexpensive method of preventing automobile foot brakes and levers from slipping when pressure



is brought to bear on same is to cut a portion of old rubber hose of the desired size and slip this over the brake

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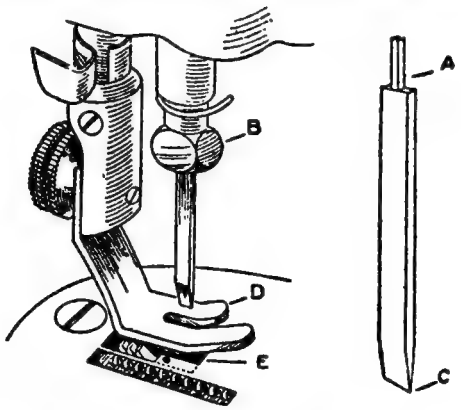
pedal in the manner shown in the illustration. If placed on in a snug and proper manner it will be found to serve the purpose as well as a covering purchased in the supply store.

Contributed by *Bert W. Verne.*

A UNIQUE CUTTING MACHINE

Anyone having recourse to an old sewing machine can readily convert it into a punching or cutting press by following the directions given below.

To begin with, shape a piece of steel as shown in the illustration; the top part being made with a shank A to fit in the needle mandril, shown at B, while the bottom part is shaped to a cutting edge, as shown in C. This piece of steel should be about the same length as the average sewing machine needle. The shank should be carefully made so that the blade will be held tightly in the mandril. The guide D must be filed a little on each side in order that the steel blade passes through with very little play. The steel plate E is also bored or filed out so that the blade can pass through.

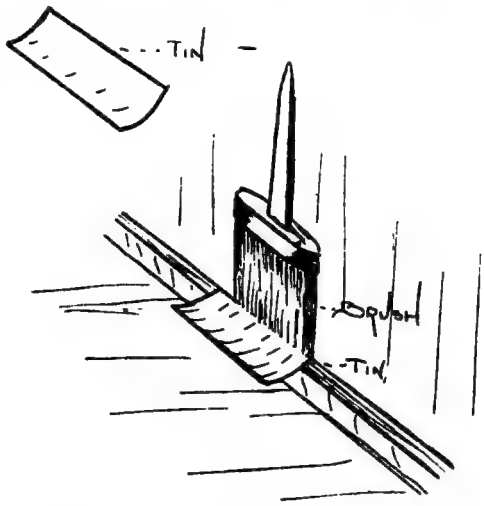


When the machine is operated in the usual way, copper or zinc sheets can be passed under the moving blade and cut to any shape desired. This machine will be found invaluable for cutting stencils for the marking of shipping cases, although this requires considerable practice.

AMATEUR PAINTER'S AID

Persons having little or no knowledge of painting can quickly and easily trace sash moldings and strips of woodwork about walls without daubing or dropping color on adjoining parts if they secure a small piece of tin such as shown in the sketch.

This is held in the left hand so as to be directly under brush as it is



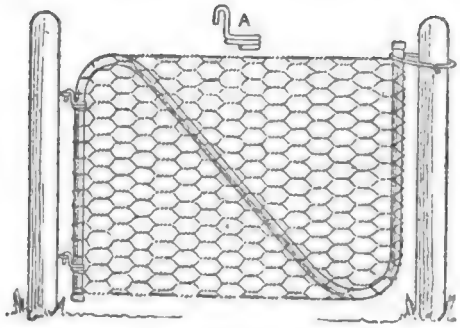
swiftly moved along the edge of the surface to be painted.

Contributed by *Bert W. Verne.*

A SIMPLE GARDEN GATE

Anyone desiring to construct a simple garden gate without involving any appreciable expense can do so by following the instructions given below:

Bend a piece of iron pipe as shown in the diagram in the form of a Z. Fasten some wire netting over this iron pipe and make two hinges as shown at A, using two screw eyes on one of the posts for holding the gate. The gate is then



complete and may be used for any enclosure such as a poultry yard.

MAKING DOORS AIR TIGHT

During the cold winter months considerable difficulty is experienced in preventing the air from entering a home be-

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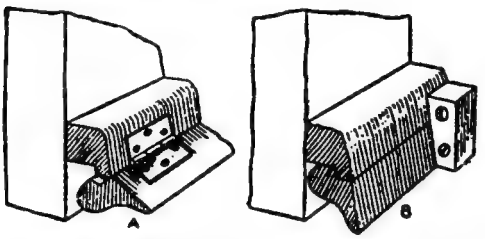
tween the bottom of the door and the threshold. This may be prevented by employing the simple method shown in the accompanying sketch.



On the bottom of a door, nail or screw a piece of wood to which is hinged another piece shaped as indicated. The bottom piece will normally be in the position indicated at A. However, when coming in contact with a stop as at B, it will assume the position shown.

This device insures the perfect closing of the door and prevents draughts from coming into the house. Normally the device will not interfere in any way, with the operation of the door, but will operate automatically when the door is closed.

A UNIQUE LABOR-SAVING ARTICLE

A recently invented European labor-saving device is shown in the accompanying illustration and is employed for handling coins. It is well known that picking coins from a flat surface is somewhat of a slow and tedious task. By means of this new device it is possible to place the coins in the hand with the least amount of exertion. It is usually

made of either wood or metal and is exceedingly strong and unbreakable.

SOLDERING FLUX

A good soldering flux for sheet iron is made by dissolving pure zinc in muriatic acid. When the acid ceases to attack the zinc, drop a few crystals of blue vitriol into the solution. The solution will then turn a light green.

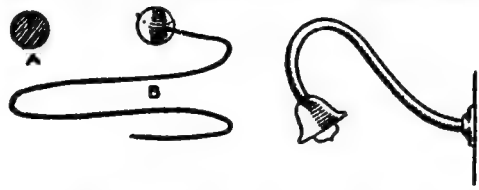
To use, scrape the surface to be soldered with a knife, then apply the solution. Upon its coming in contact with the iron, a thin deposit of copper is formed to which the solder will readily adhere.

Contributed by *H. Lorillard Miller.*

PASSING WIRES THROUGH FIXTURES

A simple method of passing wires through fixtures is described in the following and illustrated by the accompanying sketch:

Take a small lead weight such as is used for fishing of a size sufficiently small to pass through the fixture that is to be wired. Cut a slot as shown in the illustration at A, so as to hold a piece of string as shown at B. Insert the lead weight in the fixture and by holding the fixture downwards the weight will go through its entire length, pulling the cord after it. As soon as the weight has



reached the other end, it is an easy matter to fasten the wires to one end of the string and pull them through the fixture, thus completing the work.

SIMPLE METHOD TO DETERMINE RESISTANCE

It often happens that one desires to know the resistance of a coil or of electrical instruments. The cost of a Wheatstone Bridge is prohibitive to most persons. The following is a cheap and fairly accurate method that is available for practically every one. The material required comprises a volt-meter, double-pole, double-throw switch, several dry cells and a coil of known resistance such as a 75-ohm telephone receiver. Connect the instruments according to the accompanying diagram.

When the switch is thrown in one direction the current will flow through the known resistance and the volt-meter. Take a reading from the volt-meter

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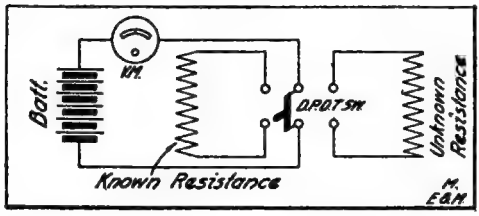
which we will consider as 4 volts. Next, throw the switch to the other set of contacts which will cause the current to pass through the unknown resistance and volt-meter. Then take the second reading which we will say is 2 volts. To find the resistance of the known coil the following proportion is then used:

$$4:2 :: x:75$$
$$2x = 300$$
$$x = 150 \text{ ohms for the unknown coil.}$$

Of course, the foregoing figures are only employed to illustrate the method of determining resistance by this means. It is necessary to substitute the volt-meter readings as well as the resistance of the known coil for those given above. In the example given, 4 represents the first reading, while 2 is the second reading; x equals the resistance of the unknown coil and 75 represents the resistance of the known coil.



While this method is not as accurate as that employing an expensive Wheatstone Bridge, it will serve the purpose of the average amateur satisfactorily.

Contributed by

William J. Baker.

PROTECTING LABELS

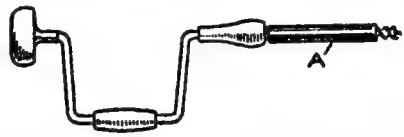
To preserve the labels on bottles, boxes, etc., from dirt and moisture, give them a coating of paraffine wax. A thin uniform coat of paraffine may be applied by melting the wax in a tin dish, allowing a brush to soak for a while in the hot wax, and then drawing the brush quickly across the surface of the label.

Contributed by *Howard S. Miller.*

A DRILLING SUGGESTION

When it is desired to bore a hole to a certain depth in a piece of wood or metal, trouble is often encountered, as it is difficult to determine accurately when the depth has been reached. It often happens that the drilling is continued too long without the knowledge of the worker.

A simple depth gauge may be made by fitting a brass or fibre tube over the bit or drill as shown at A in the accompanying sketch. If it is desired to bore a hole two inches deep the tube should



cover all of the drill with the exception of the first two inches. This will prevent the worker from drilling beyond the depth desired.

THE CHEMICAL ETCHING OF GLASS

Glass is regarded by most people as a non-corrosive, unchangeable material which has no chemical reaction. This, however, is untrue. Glass is made chiefly by the heating of sodium carbonate and lime in an excess of clean sand. Now sand is an impure form of silicon dioxide, and all silicon compounds are readily acted upon by hydrofluoric acid.

Advantage is taken of this fact in etching designs on glass. The glass vessel or plate is given a coat of paraffine wax, upon which the acid will not act, the parts which it is desired to make opaque being left unprotected. The wax-coated glass is then exposed to the fumes of the acid for a couple of minutes and then washed clean in water warm enough to melt the wax. Wherever the hydrofluoric acid fumes have come in contact with the glass its lustre is destroyed, making it opaque.

On account of its action on glass the acid is kept in wax bottles.

Extreme care should be used in handling hydrofluoric acid, as its fumes are very poisonous, and a single drop will make a sore on the hand which is very painful and slow in healing.

Contributed by *John C. Crowley.*

A SIMPLE CHAIR SILENCER

To eliminate the noise caused by moving a chair about a wooden floor, the method shown in the accompanying sketch will be found very useful. Bore a hole in the legs of the chair about one inch deep and of a sufficiently large di-

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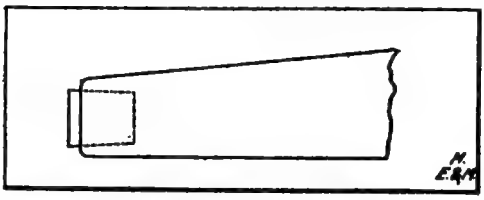
ameter to accommodate a rubber stopper. The rubber stopper is then inserted as shown leaving only a short portion ex-



posed. It will then be found that the chair can be moved about silently.

THE RENEWAL OF EDISON FUSE PLUGS

Many of our readers have doubtlessly (and correctly) thought that a considerable saving might be effected by inserting a new piece of fuse wire in a blown out fuse plug, and have tried to act upon that thought, with the result, perhaps, of melting the new piece of fuse wire in two while attempting to solder it in place. This job can, however, be successfully done, the only materials necessary being the new piece of fuse wire, a pocket knife, a piece of heavy iron wire bluntly pointed at one end and a means for heating it.

Remove the brass cover from the fuse plug by running the blade of a knife under the turned over edge, and remove the old fuse wire, leaving, however, the beads of solder which fastened it to the pin in the bottom of the plug and to the outer shell of the plug. Take a piece of fuse wire of the desired capacity and of sufficient length, and scrape the ends of it until the bright metal is exposed.

Now heat one end of your iron wire to a dull red, touch it to the bead of solder in the bottom of the fuse plug, withdraw it and instantly plunge one end of the fuse wire, which you have been holding in your other hand, into the middle of the melted globule of solder. If the wire was scraped clean, it will stick at once.

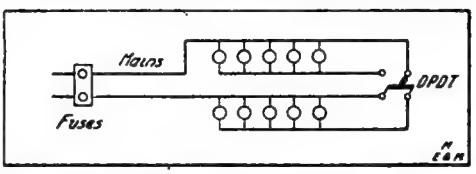
Now put the free end of the fuse wire through the hole leading to the outer shell of the plug, keeping it pushed as far from the bead of solder as possible. Again heat the iron wire, and touch it to the outer bead of solder, being careful not to touch the fuse wire. When the solder has melted, quickly bend the free end of the fuse wire into the melted solder, using a knife blade to push the wire where you wish it. This operation of soldering to the outer shell may be most easily accomplished by clamping the plug in a vice with the bead of solder upwards.

In this manner, after a few trials, you will find that you can quickly and easily renew the wire in a plug, and have a fuse as good as new at a cost which is a fraction only of the price of a new plug.

Contributed by *Howard S. Miller.*

A NOVEL ELECTRIC LIGHT CIRCUIT

The accompanying diagram shows a novel method of connecting lamps when it is desired to control them by a switch



located in the rear of a building, a considerable distance away from the supply wires. This diagram eliminates the necessity of running back a third wire from the switch to the supply lines.

Contributed by

James J. Kertz.

HOW TO MAKE AN ALCOHOL STOVE

A simple alcohol stove forms a valuable addition to the tool kit of any one, and the author has endeavored to give in the following paragraphs a simple description on the construction of such a device.

The burner for the stove was made from a small brass box such as paper fasteners are packed in. This was stuffed nearly full with asbestos that was obtained from a piece of old asbestos pipe covering. A piece of sheet asbestos broken up into small bits will answer the purpose equally as well. A piece of fine mesh wire screening was then cut out to a diameter slightly larger than that of the box. The edge being then crimped over, it was forced down into the top of the box, serving to keep the asbestos filling in place. This completed the work on the burner.

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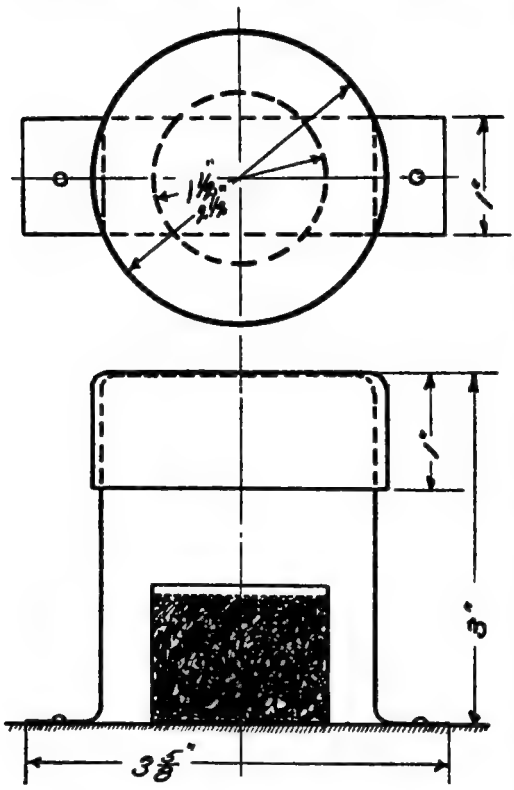
The stand was made from the bottom of an old tin can 2½ inches in diameter. The can was cut off near the bottom so it stood only 1 inch high. Then a piece of band iron, 1 inch wide, was bent into the shape shown in the illustration and forced into the bottom of the can, as shown. This made a stand just the right size for supporting a pint cup. Although not absolutely essential, it is well to make a base for the stove out of a piece of wood, fastening the stove to the base by means of screws or nails



through the feet of the band iron. A piece of sheet asbestos on top of the wood makes a good addition. The writer used a porcelain cup when boiling water, but if a tin cup is used, the water will heat quicker and use less alcohol.

The stove is operated by pouring as much denatured alcohol (denatured alcohol used on account of its cheapness) into the burner as the asbestos packing will absorb. The burner can then be lighted with the flame of a match. The heat generated by the burning alcohol will be sufficient to vaporize the alcohol held in the asbestos packing, thus insuring a large and steady hot flame. To extinguish the flame at any time, simply slide the brass box cover over the top of the burner, thus cutting off the supply of air, and extinguishing the flame at once. If the stove is to be used but for a few minutes at a time, put only a few spoonfuls of alcohol in the burner, as any excess after the flame has been extinguished will be lost by evaporation.

The writer has found this alcohol stove very convenient for use in soldering small articles, as they can be heated directly in the flame.

Rosin is usually sufficient as a flux, and solder is applied directly to the object without the use of a soldering iron. This process is called "solder sweating," but solder flux, if finally washed off, permits a surer adhesion than rosin. The alcohol gives a clear flame which is very essential for successful soldering, as solder will not stick to dirty or cold metal.

Contributed by *H. M. Nichols.*

TO CUT GLASS

Often one desires to cut glass when neither diamond nor glass cutter is at hand. It may be that the neck of a bottle has to come off to make a jar for some particular purpose; or, perhaps, a piece of glass has to be cut to repair a window. The following method will generally be found to succeed, though it sometimes requires a little patience. Take a piece of wire (one-eighth to three-sixteenth inch wire is a good size), heat it to a dull red and press it firmly for about half a minute on some part of the line along which the glass has to be cut. Then remove it, moisten the top of a finger and touch the spot where the wire has rested. This will generally start a tiny crack in the glass, but if it does not the operation must be repeated until it succeeds. Once the crack is started, by placing the hot wire immediately ahead of it the crack can be led in almost any direction that is desired. As the crack advances, the wire, of course, must be moved ahead of it along the desired line.

After the glass is cut, the sharp edges can be rubbed off with a piece of emery cloth or sand paper wrapped around a stick, or with a piece of stone, such as is used for sharpening tools.

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A New Rotary Receiving Transformer

An Unusually Neat and Efficient Receiving Instrument That May be Readily Constructed

By P. Mertz

Illustrated from drawings made by the author.

THE "stumbling-block" for most amateurs in constructing a rotary loose-coupler is the necessity of passing the shaft, upon which the secondary pivots, through both windings. If each coil consists of only one winding, the wire is

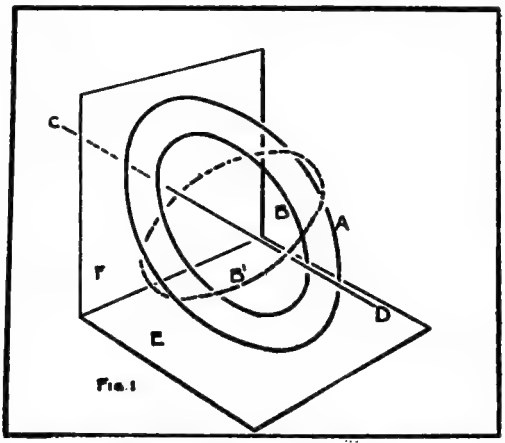

Fig. 1

bunched around the shaft and looks anything but neat. To avoid this, each coil is often made in two windings, but for several reasons this is unsatisfactory. First, it greatly complicates the construction of the loose-coupler; then it greatly weakens its mechanical structure and it also decreases the efficiency of the instrument somewhat in weakening the magnetism produced by the coils. For these reasons many amateurs would welcome a design in which the shaft does not pass through either of the coils. Such a design has been brought forth by the writer and is shown in the accompanying illustrations. Aside from the advantages mentioned above, it has a more accurate coupling adjustment since a half-turn of the adjusting knob is required to change from closest to loosest coupling, instead of only a quarter-turn as usual. Moreover, in spite of these improvements, the construction of the new loose-coupler is simpler, if anything, than the old design.

The principle of operation of the instrument may be seen from Fig. 1. In the illustration, A represents the primary coil, B the secondary coil, and CD the shaft. These are all mounted upon the base, E, having an upright, F, at one end. It will be easily seen that if CD is rotated half a turn, B will rotate with it and come to the position B'. If, now, both A and B are at an angle of 45° to CD, B' will obviously come at right angles to A. This is evidently the same result that is obtained in the usual type of loose-coupler, but the shaft, CD, does not pass through either of the windings.

The actual instrument is shown in side elevation in Fig. 2, and in front elevation in Fig. 3. As explained before, its essential parts consist of the primary coil, A, the secondary coil, B, and the shaft, D, all mounted upon the base, E, and upright, F.

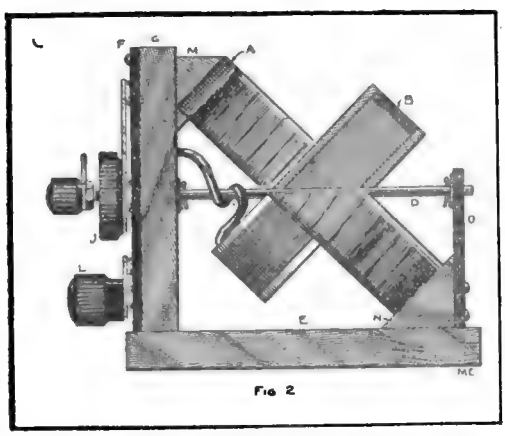
Fig. 2

The working drawings of the coil, A, are shown in Fig. 4. It is made by winding a ribbon of flexible micanite, celluloid, cardboard, or other insulating medium 1 in. wide over a disc of wood 4 in. in diameter. The disc is put on a winding-machine, the outer surface of the coil-form shellacked, and the wire

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wound on evenly. Taps should be taken out every second turn, until 14 turns have been reached; then every 14 turns until 84 more turns have been reached.

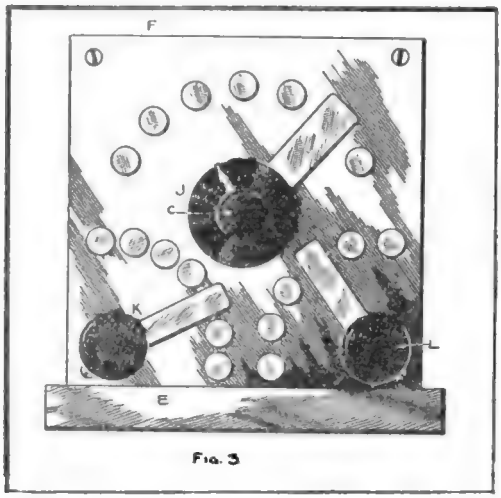

Fig. 3

The method of connecting these to the switches will be explained later. When the shellac is dry, the coil should be removed from the disc, and neatly taped with silk or cotton insulating tape. This is painted over with asphaltum, and when dry the coil will be entirely finished. The various steps in this construction may be clearly understood by reference to Fig. 4a.

The working drawings of the secondary coil, B, are given in Fig. 5. Here it will be seen that the coil-form con-

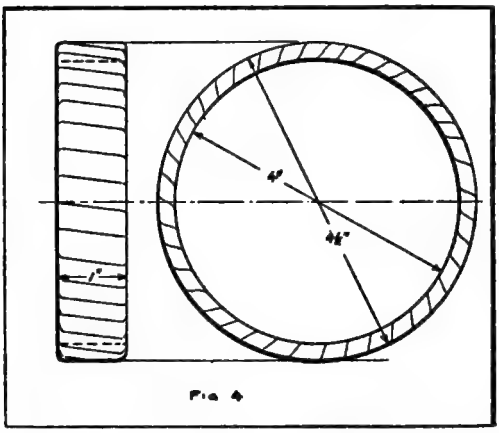

Fig. 4

sists of a wooden disc glued between two discs of thin wood veneer, hard-rubber, or heavy cardboard of a slightly greater diameter. A small hole in which to mount the shaft is drilled at the center of the coil at an angle of 45° to the latter. The wire is now wound on, taps being led out every 15 turns, until 105 turns have been wound on. It may be stated here that in constructing the primary and secondary coil-forms, if it is possible to obtain the use of a lathe, these should be turned solid out of wood or other insulating material as a much neater job will result.

The working drawings of the base, E, and upright, F, are shown in Fig. 6. The base needs no explanation, but something may be said concerning the upright. A neat manner of constructing this part and concealing the wiring to the switches at the back, is shown in the working drawings. The part carrying the switches and connections consist of a hard-rubber sheet, F, at the back of which is screwed a neat wooden frame, G. A shallow rabbet is cut at the back of this frame to admit a sheet, H, of

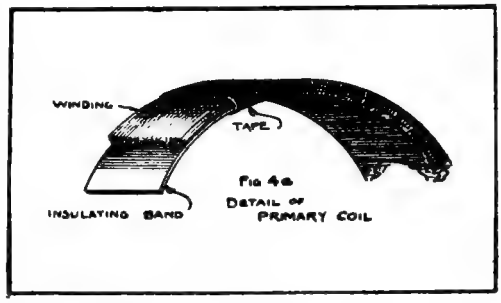

Fig 4a
Detail of Primary Coil

micanite, hard-rubber, or any other suitable insulating material, which covers up and conceals the wiring.

The complete details of the secondary switch are shown in Fig. 7, together with the shaft, D, which carries the secondary coil. It consists of a hard-rubber knob, 1, having a ¼ in. hole drilled through its center. To this knob is screwed the brass switch-lever, 2, the end of which bears upon the contact-point, 3. These parts are of the same general type as described by the writer on page 45 of the April, 1913, issue of *Modern Electrics*. The knob, 1, pivots upon the brass tube, 4, which also makes electrical contact with lever 2 through the heavy brass washer, 5. This tube, 4, is threaded with a 14-24 machine screw thread. At the front end a thin brass nut, 6, is screwed on, and neatly soldered there. At the back a somewhat heavier nut, 7, is screwed on, but not

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soldered. This latter has a small phosphor-bronze spring compressed under it, to keep up an even friction between 2

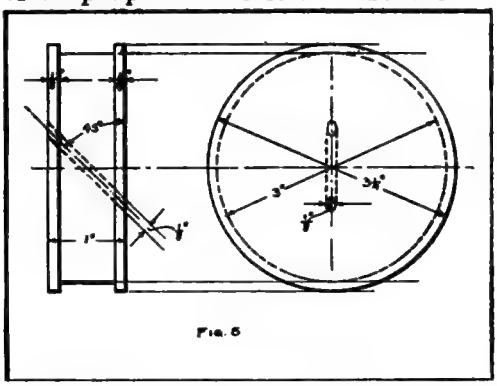

Fig. 5

and 5. The connection to the switch-lever is to be soldered to the nut, 7.

substituted for those mentioned above, but the elimination of dead-ends does not increase the efficiency of the instrument to as great an extent as might be thought from reading some articles which have recently appeared on this subject. The use of two switches for the primary allows of extremely close regulation, and yet keeps down the contact-points to a reasonable number. In use, the right-hand (coarse adjustment) switch is adjusted first, and then the left-hand (fine adjustment) is used for close tuning. A little thought will show that this takes less time than is required for adjusting a single switch having only a *fairly* close regulation.

The exact shape and construction of the pieces, M and N (upon which lat-

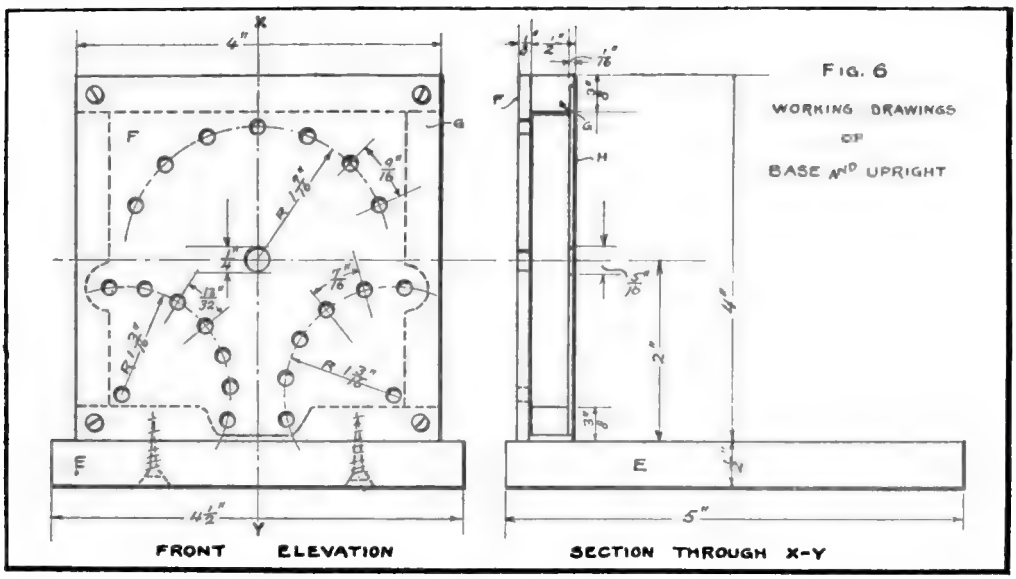

Fig. 6
WORKING DRAWINGS
OF
BASE AND UPRIGHT

The shaft, D, consists of a brass rod ⅜ in. in diameter and is threaded with an 8-32 M. S. thread at one end. A small electrose knob C, is screwed over this end and a small brass index, 8, clamped between it and a nut, 9. Small brass cotter-pins, 10, are inserted at the places shown on the shaft, D, to limit its longitudinal play.

The primary switches, L and K, are very nearly the same as the secondary switch and working drawings of them are shown in Fig. 8. The construction and dimensions are self-explanatory and need not be described further. If desired, no dead-end switches, such as were described on page 476 of the August, 1913, issue of *Modern Electrics*, may be

ter the support, O, is also mounted) which hold the coil A to the base and

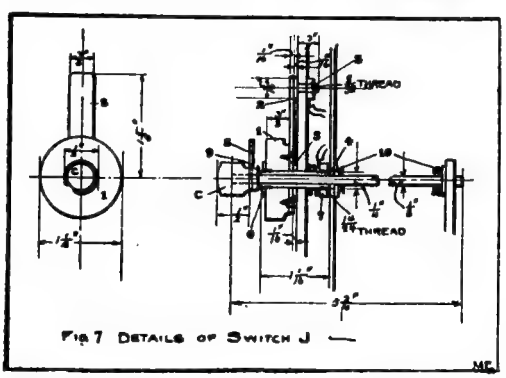

Fig. 7 Details of Switch J

upright, may be easily seen from Fig. 9, which gives working drawings. These

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are first cut from a rectangular block with a saw, the grooves cut out with a gouge and chisel, and finally sandpapered.

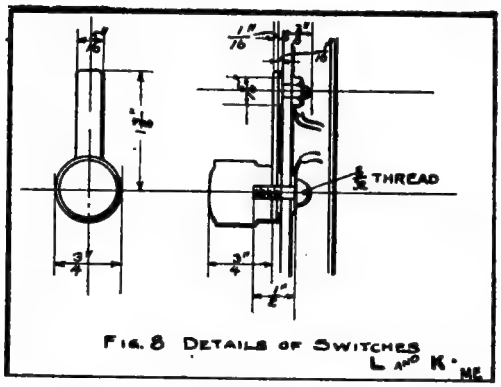

FIG. 8 DETAILS OF SWITCHES L AND K.

After all the parts have been constructed and seen to fit together, they should be finished. The wooden parts should be stained and varnished or polished, the latter giving a far more beautiful effect. The hard-rubber parts should be well rubbed, using a little carbon disulphide if necessary, to get a good polish. The brass parts are also to be polished and then lacquered, a good procedure for which was described by the writer on page 140 of the May, 1913, issue of *Modern Electrics*. If desired, the metal parts may be nickel-plated, but besides being more difficult than lacquering, this does not look nearly so well and somewhat lowers the efficiency of the instrument.

The loose-coupler is now ready to be wired and on account of the fact that two switches are used on the primary, the diagram may be unfamiliar to some readers and for this reason is reproduced herewith in Fig. 10.

The loose-coupler which has just been described has a wave length of about 1,000 metres, but by altering the dimensions an instrument of almost any maximum wave length may be obtained. If well made according to the specifications given above, this rotary transformer will not only be easier to construct than many other types, but will be a good deal stronger and more substantial, aside from giving better service. It can be adapted to be used as a variometer.

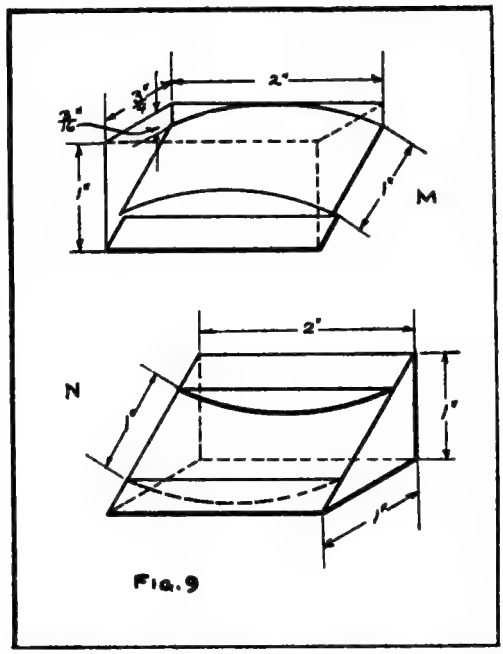

FIG. 9

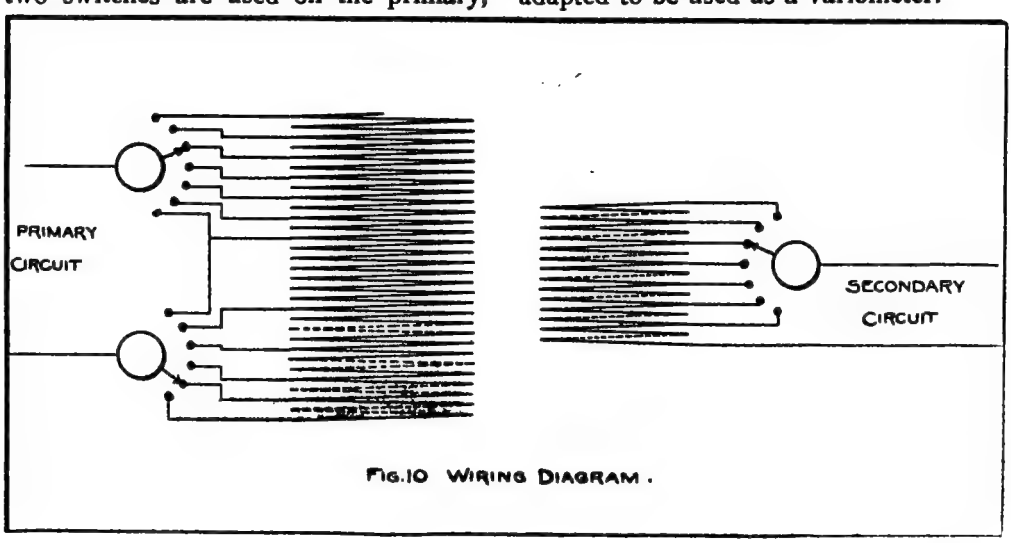

FIG. 10 WIRING DIAGRAM.

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Simple Home-Craft Furniture

The First of a Series of Articles Describing the Making of Various Pieces

By G. Lane.

Illustrated from drawings made by the author.

ALTHOUGH our modern furniture stores supply us with every kind and style of furniture, at almost any price we are willing to pay, factory-made furniture is not always appreciated as much as something we make ourselves. A young man might well be proud of his room if he can say he made practically all the furniture in it. And so, under this title, drawings are going to be given, for practically all the furniture needed to furnish a boy's room, one piece at a time.

The first thing to be considered is the necessary material. Of course, quarter-sawed white oak is the best wood for cabinet work; it has beautiful grain, and is not apt to warp or shrink. But sometimes the price is very high, or perhaps the best grade is not obtainable. Plain sawed red oak is next in rank, often having very beautiful grain looking better in a piece of furniture than quartered oak that has not been carefully selected. There are several other woods that might be used, although oak should be employed if possible. Cypress might be used to good advantage; it is very soft, works easily, and takes a nice finish. It is more suitable for porch or lawn furniture, however.

One cannot be too careful in buying lumber for cabinet work. Nothing is more discouraging to an amateur cabinet maker than to find his lumber warping out of shape before he even gets it cut to size; or to find that the furnace heat has curled a table top in one winter's use. This may be prevented to some extent by storing the lumber in a dry place, and if necessary, clamping several boards together with hand screws. Clear, select, kiln-dried lumber, free from sap, knots and shakes, should always be bought; remember the best is none too good for cabinet work. If the wood has knots or shakes, there is considerable waste in cutting to avoid these. If there are sap streaks they will stain a different shade.

A small piece of furniture has been selected for the first—the foot or leg rest. This will be found handy as well as comfortable. A cushion for the top is desirable, and one of brown demins or linen crash is suggested; or perhaps imitation or real leather. Remember, the cushion should be just a little smaller than the top of the rest. The shelf underneath will be found handy for papers and magazines, and the drawer, which opens from either side, is to accommodate house slippers. The oak for this can be purchased in one piece, and the whitewood in one piece, as shown in drawing.

First, saw off square the two upright pieces for the ends, and the three pieces for the shelves. Use the best part of your board for the ends and top as they are the pieces that will show the most. Now smooth up all surfaces that are going to show; that is, both sides of the end pieces, and the top of the first and second shelves. This may be done with a cabinet scraper, although a very sharp, smoothing plane is faster and better if handled carefully. Smooth also the edges of all pieces. Be sure all pieces are exactly the right length and square. Lay out the rounding parts at the top and bottom of the end pieces. Saw these if possible on a band saw or jig saw; if done by hand, saw as near as possible to the line, on the top end, with a common saw, and finish with a sharp plane or spoke shave. In cutting the curved parts at the bottom by hand, it is suggested that a row of holes be bored just inside of the line, then connect these holes with a compass or turning saw. Finish up with a sharp gouge. Lay out grooves for the cross pieces, and saw if possible with a miter saw, taking the waste wood out with a chisel. Bore gimlet holes for the screws and assemble these pieces without glue,

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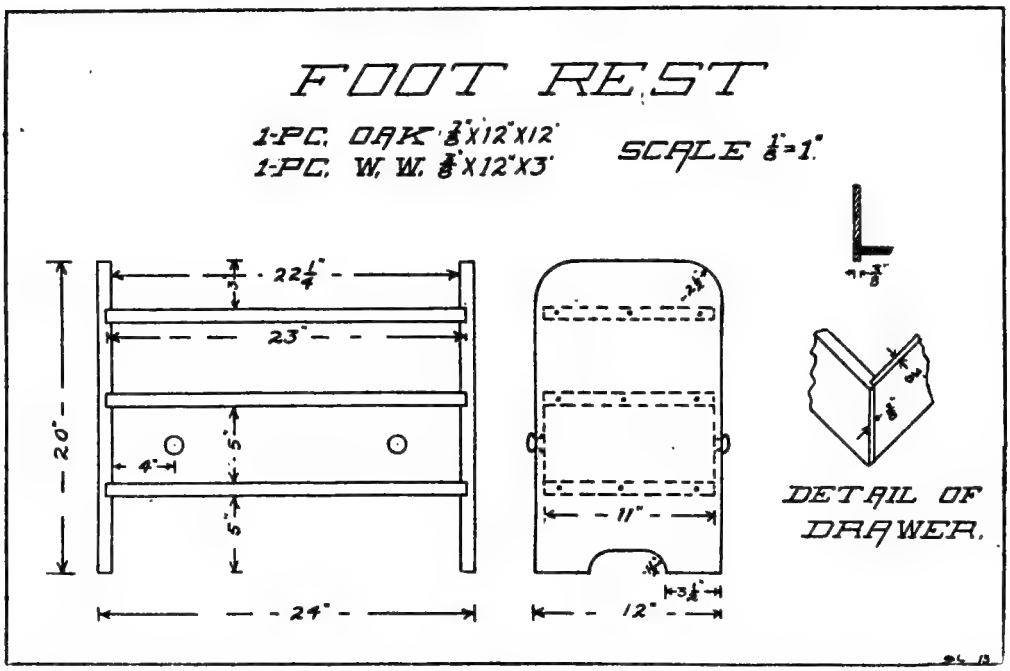
using 1¾-inch round head blued screws. Measure the space for the drawer, and see if it corresponds with the drawing. Cut out the drawer fronts to fit the openings and then rip out the sides of the drawer, using the remainder of the whitewood for the bottom of the drawer. The grooves necessary in making the drawer may be ripped out very quickly on a circular saw, or cut in with a rabbeting plane. Wooden knobs are suitable for this drawer, although if these cannot be turned or bought, a copper or oxidized pull looks very good. After the drawer has been assembled and fitted, take out the screws from the end pieces, taking



everything apart, and glue the joints. Put together again quickly, using furniture clamps if necessary. If preferred the pieces may be stained and then put together. Be sure to stain every side of every piece, or the moisture will work into the unfinished side and not the finished, and the piece will warp.

FINISHING.

The next important step is finishing. This will be covered at this time, so it will not be necessary to repeat it in the other articles that will follow. A suitable finish must be decided upon, depending somewhat upon the wood. The first necessity of a good finish is a good surface upon which to put the finish. Before any finish is applied, the work should be examined carefully, to see that it is free from planer or sander marks. Passing the tips of the fingers over the surface should help to locate any that escape the eye. All worm holes, nail holes or other imperfections should be filled with beeswax or crack filler, colored to match the stain. The surface is generally sand-papered, although sand papering fills the grain of the wood with a dust of sand and wood that keeps the stain from penetrating properly, hindering the stain from bringing out the grain as it otherwise would, and causing a cloudy looking finish.

The particular shade or color you desire to stain your furniture depends, of course, upon your individual choice. You may wish to match furniture already in use, or to match the woodwork in your room. The real dark, almost black shades are being replaced by the softer, more pleasing shades of brown, thus giving a greater chance for a harmony of pleasing colors in the interior decorations of the room. Wall coverings, curtains, rugs, etc., may be obtained that make very artistic color schemes with brown furniture.

Having decided on what shade is desired for the finish of the furniture there are two separate ways you may

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obtain them. It is possible to buy prepared stain, picking out the desired shade from a stained sample, or one may mix the stain himself. Both ways have their advantages. The prepared stains are costly, but you are practically sure of good results providing a reliable stain is used, and the shade may be duplicated months afterwards on another piece if desired. If you mix your own stain, you can experiment until the desired shade is found, but if you wished to stain another piece to match, you would probably experiment for some time before the same shade was reached. Mixed stains often cloud the grain; prepared stains bring out the grain better, particularly in oak.

If prepared stain is used, a good penetrating oil stain is recommended, or a reliable spirit stain, although spirit stains, generally speaking, are harder to apply on large pieces than oil stains, as the spirit stains dry very fast and the brush marks sometimes show where they lap. Spirit stains must be wiped off as you go along, while oil stains are left on several minutes, generally, before rubbing off. Explicit directions should accompany each can of prepared stain. Whatever stain is used, experiment on a piece of scrap wood in order to determine just how long to leave it on to get the desired shade.

A good stain is made in the following manner: Mix burnt turkey umber with raw linseed oil to form a paste, then thin with turpentine. The dry powder may be used, but better results follow if the umber is ground in japan. This shade may be darkened by adding drop black in small quantities, or made a lighter and more reddish brown by adding burnt sienna. A filler may be added in the form of silex, or if silex is not obtainable, add a small quantity of pumice stone and whiting. Another good stain is made by thinning asphaltum varnish with turpentine.

With either stain the filler may be applied separately and obtained in a paste form to match the stain. The final coats in finishing depend upon the wishes of the finisher. The piece may be given a coat or two of thin white shellac, or one coat of thin shellac and one or more coats of furniture wax. The wax may be bought ready for use, or it may be made by melting beeswax with a little paraffine, and after it is taken from the fire add enough turpentine to make it soft when it cools. The turpentine is very inflammable, and should not be added while the wax is near the fire. Several firms have on the market what they call "dull finishes." These are suitable for mission furniture, giving something of the effect of rubbed varnish.

Whatever finishes are used, one can not apply them too carefully. It is suggested that you wait twenty-four hours between coats, and wax should stand several days before another coat is applied.

FRENCHMAN INVENTS ENGINES OF DEATH

An obscure inventor named Sava Rogozea has just demonstrated discoveries which promise to revolutionize rifle firing.

His invention consists of a special cartridge and double inflammable bullet, primarily designed for the destruction of airships. In his experiments Rogozea used an old gun bullet. Although his cartridge was filled with powder, spectators were astonished to see neither smoke, flash, nor recoil as he fired, the strange, long bullet traveling fleet and straight to the butt, instead of executing a series of irregular bounds, as it should have done, according to accepted balistic laws. The bullet carried 1,200 meters, but it is calculated that with a modern rifle it would have carried 3,000 meters.

Rogozea also claims to have invented a cannon costing only 300 francs, or about $60, easily carried by two men, which can throw a shell 7,000 meters. Another invention which he has brought forward is a shrapnel shell which scatters its contents along the level of the ground.—*Dr. Leonard K. Hirshberg.*

A CORRECTION

'Attention is drawn to an error that was made in the article entitled, "The Seibt Direct Reading Wave Meter" that appeared on pages 25 and 26 of the January issue. The price on this instrument was quoted at about $40.00 in Germany, or $58.00, including duty in the United States. These prices are incorrect and should be $282.00 in the United States, duty paid.

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THE EDITOR'S DESK

Judging from the many pleasing comments that have been received regarding the January issue of the new consolidated magazine MODERN ELECTRICS AND MECHANICS, it is evident that the editorial policy of this publication is meeting with the approval of practically all the readers.

The attention of all the readers is directed to the excellent article on the construction of small alternating current motors prepared by Dr. A. E. Watson, E.E., Ph.D., which was promised for the January issue, but could not be prepared in time to be used in that number. This article, to our knowledge, is the first of its kind ever published. By following the directions given by the author, any reader can construct a small alternating current motor of any size best suited to his requirements.

In this issue may be found several articles of unusual interest. For instance, there appears an article on the art of bending wood that is highly instructive and interesting. Almost every reader has, at some time or other, attempted to bend wood and met with failure. But the bending of wood is simple if one knows the secret. Read the article and acquire the knack!

Probably no less interesting is the article describing the making of an attractive foot rest. This article is the first of a series that will cover the making of every piece of furniture necessary for the room of a boy. All the pieces described will be designed along substantial lines while at the same time possessing pleasing appearance.

The first instalment of the series on the construction of high frequency, X-ray and ozone apparatus should prove of interest to practically all readers. In this first chapter the construction of a large coil is explained. A chapter will be published each succeeding month until the entire series has been completed.

The leading feature of this issue is the article on explosives that was announced in the January issue. Owing to the great length of this article it has been found necessary to publish it in two or three parts. Every well-known modern explosive is covered in the article and it is written so as to entertain as well as instruct.

All contributors to the Experimental Department should bear in mind in submitting articles that they must contain some original idea. Although improvements on previously described apparatus or experiments may sometimes prove of sufficient interest to warrant publication, it more often happens that the improvements do not contain sufficient merit. The scarcity of snappy, original contributions has necessitated the reducing of the number of articles appearing in the Experimental Department of this issue, since it is our desire to publish only the best of articles for the readers of MODERN ELECTRICS AND MECHANICS.

Many inquiries have lately been received asking whether there is danger from lightning when an aerial is erected on a building. This subject has been covered several times in this magazine, but for the benefit of those inquiring at present, a few comments will be made here. If an aerial is properly insulated and grounded during thunder storms, there is absolutely no danger from lightning. The rules of the Fire Underwriters require that the aerial be grounded through a 100 ampere switch and the ground lead be at least a No. 4 B. & S. conductor or equivalent. The ground connection through this lead must be made on the supply side of the water meter. When an aerial is properly grounded, it acts in the same capacity as a large lightning rod, and rather than endanger property, it protects it from damage by lightning by offering a low resistance path for the bolt to discharge to the ground. It is best to have the installation examined by a Fire Underwriter inspector in each instance.

Among the many leading articles in the March issue will be an interesting and original contribution on the Edison effect and valve detectors. This article not only covers numerous points regarding valve detectors, but it also contains the results of considerable research work on the part of its author. The instalments of all the serial articles will also appear—the second chapter on the making of high frequency, X-ray and ozone apparatus, the second part of the article on explosives in which modern compositions will be dealt with, and the second article on the making of furniture for a boy's room, which in this instance will cover the construction of an arm chair. There will also be an article describing the electrical equipment of that leading engineering achievement of modern times—the Panama Canal.

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What and Why Is the Internal Bath?

By C. Gilbert Percival, M. D.

THOUGH many articles have been written and much has been said recently about the Internal Bath, the fact remains that a great amount of ignorance and misunderstanding of this new system of Physical Hygiene still exists.

And inasmuch as it seems that Internal Bathing is even more essential to perfect health than External Bathing, I believe that everyone should know its origin, its purpose and its action beyond the possibility of a misunderstanding.

Its great popularity started at about the same time as did what are probably the most encouraging signs of recent times—I refer to the appeal for Optimism, Cheerfulness, Efficiency and those attributes which go with them and which, if steadily practiced, will make our race not only the despair of nations competitive to us in business, but establish us as a shining example to the rest of the world in our mode of living.

These new daily "Gospels," as it were, had as their inspiration the ever present, unconquerable American Ambition, for it had been proven to the satisfaction of all real students of business that the most successful man is he who is sure of himself—who is optimistic, cheerful, and impresses the world with the fact that he is supremely confident always—for the world of business has every confidence in the man who has confidence in himself.

If our outlook is optimistic, and our confidence strong, it naturally follows that we inject enthusiasm, "ginger" and clear judgment into our work, and have a tremendous advantage over those who are at times more or less depressed, blue and nervously fearful that their judgment may be wrong—who lack the confidence that comes with the right condition of mind and which counts so much for success.

Now the practice of Optimism and Confidence has made great strides in improving and advancing the general efficiency of the American, and if the mental attitude necessary to its accomplishment were easy to secure, complete success would be ours.

Unfortunately, however, our physical bodies have an influence on our mental attitude, and in this particular instance, because of a physical condition which is universal, these much-to-be-desired aids to success are impossible to consistently enjoy.

In other words our trouble, to a great degree, is physical first and mental afterwards—this physical trouble is simple and very easily corrected. Yet it seriously affects our strength and energy, and if it is allowed to exist too long becomes chronic and then dangerous.

Nature is constantly demanding one thing of us, which, under our present mode of living and eating, it is impossible for us to give—that is, a constant care of our diet, and enough consistent physical work or exercise to eliminate all waste from the system.

If our work is confining, as it is in almost every instance, our systems cannot throw off the waste except according to our activity, and a clogging process immediately sets in.

This waste accumulates in the colon (lower intestine), and is more serious in its effect than you would think, because it is intensely poisonous, and the blood circulating through the colon absorbs these poisons, circulating them through the system and lowering our vitality generally.

That's the reason that biliousness and its kindred complaints make us ill "all over." It is also the reason that this waste, if permitted to remain a little too long, gives the destructive germs, which are always present in the blood, a chance to gain the upper hand, and we are not alone inefficient, but

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really ill—seriously, sometimes, if there is a local weakness.

This accumulated waste has long been recognized as a menace, and Physicians, Physical Culturists, Dietitians, Osteopaths and others have been constantly laboring to perfect a method of removing it, and with partial and temporary success.

It remained, however, for a new, rational and perfectly natural process to finally and satisfactorily solve the problem of how to thoroughly eliminate this waste from the colon without strain or unnatural forcing—to keep it sweet and clean and healthy and keep us correspondingly bright and strong—clearing the blood of the poisons which made it and us sluggish and dull spirited, and making our entire organism work and act as Nature intended it should.

That process is Internal Bathing with warm water—and it now, by the way, has the endorsement of the most enlightened Physicians, Physical Culturists, Osteopaths, etc., who have tried it and seen its results.

Heretofore it has been our habit, when we have found, by disagreeable and sometimes alarming symptoms, that this waste was getting much the better of us, to repair to the drugshop and obtain relief through drugging.

This is partly effectual, but there are several vital reasons why it should not be our practice as compared with Internal Bathing—

Drugs force Nature instead of assisting her—Internal Bathing assists Nature and is just as simple and natural as washing one's hands.

Drugs, being taken through the stomach, sap the vitality of other functions before they reach the colon, which is not called for—Internal Bathing washes out the colon and reaches nothing else.

To keep the colon consistently clean, drugs must be persisted in, and to be effective the doses must be increased. Internal Bathing is a consistent treatment, and need never be altered in any way to be continuously effective.

No less an authority than Professor Alonzo Clark, M.D., of the New York College of Physicians and Surgeons, says: All of our curative agents are poisons, and as a consequence every dose diminishes the patient's vitality.

It is rather remarkable to find, at what would seem so comparatively late a day, so great an improvement on the old methods of Internal Bathing as this new process, for in a crude way it has, of course, been practiced for years.

It is probably no more surprising, however, than the tendency on the part of the Medical Profession to depart further and further from the custom of using drugs, and accomplish the same and better results by more natural means; causing less strain on the system and leaving no evil after-effects.

Doubtless you, as well as all American men and women, are interested in knowing all that may be learned about keeping up to "concert pitch" and always feeling bright and confident.

This improved system of Internal Bathing is naturally a rather difficult subject to cover in detail in the public press, but there is a Physician who has made this his life's study and work, who has written an interesting book on the subject called "The What, The Why, The Way of the Internal Bath." This he will send on request to anyone addressing Charles A. Tyrrell, M.D., at 134 West 65th Street, New York, and mentioning that they have read this in *Modern Electrics and Mechanics*.

It is surprising how little is known by the average person on this subject, which has so great an influence on the general health and spirits.

My personal experience and my observation make me very enthusiastic on Internal Bathing, for I have seen its results in sickness as in health, and I firmly believe that everybody owes it to himself, if only for the information available, to read this little book by an authority on the subject.

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FLYING SPARKS

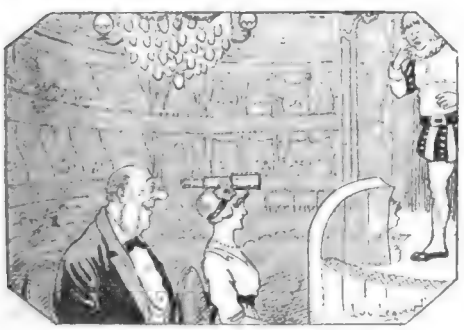
MISTAKEN

First Coster (outside picture dealer's window)—Who was this 'ere Nero, Bill? Wasn't he a chap that was always cold?

Second Coster—No; that was Zero; anuver bloke altogether.—*Tit-Bits.*

A NEW THEATRE HAT

In going to the theatre, Mr. Groucho walks in front of his wife, who is wearing an artistic hat.



In the theatre, however, he sits behind her, and the usefulness of the hat becomes evident as well as the reason for the sudden politeness.—*Le Pele Mele.*

NOT VACUUM CLEANERS

"Mind cures are not always successful."

"Of course not. They've got to have something to work on."—*Baltimore American.*

NEVER QUIT

"In the old days doctors used to bleed patients for most of the diseases."

"They still do, my boy; they still do."—*Detroit Free Press.*

A PATRICIAN

"Why did she withdraw after receiving the nomination?"

"They told her, if elected, she would become a member of the Common Council, and you know how particular she is."

IT DID NOT MATTER

Doctor—Tell me, my friend, what do you take as an aperitive?

The Patient—It will be whatever you desire, Doctor; I have no particular preference.—*Le Pele Mele.*

ELDER SISTER

The One—"Who is the girl that just passed?"

The Other—"That's Miss Nutt."

The One—"Hazel?"

The Other—"Ches."—*Illinois Siren.*

Google

Selenium and Selenium Cells

By Wm. R. Bowker

SELENIUM, an element belonging to the sulphur group, was discovered by Berzelius in 1817. This metalloid appears like sulphur in various modifications. When newly obtained by precipitation with acids out of a solution of selenic acid, it forms an amorphous brick-red powder. By melting and then slowly cooling this, we obtain a black, shining and brittle mass, in appearance much like sealing-wax. In this state, selenium is almost a non-conductor to electricity.

The conductivity is, however, improved by slowly heating this form of selenium to 200 degrees Centigrade, when the selenium assumes a crystalline condition, having a gray, metallic-looking surface. In 1873 it was discovered that the element selenium in its metallic state possessed the wonderful property of having its electrical resistance decrease under the influence of light and it was subsequently found that the greenish-yellow rays of light were the most active. It has also been shown that the change of resistance varies directly as the square root of the illumination and that the electric resistance is less with a high electro-motive force than with a low one.

Among the first who tried to put this remarkable property possessed by selenium into practical use was Werner Siemens. In 1875 he devised a selenium cell consisting of two platinum wires, wound in the form of flat spirals; the selenium being formed into narrow strips between these. In constructing a photometer, Siemens successfully obtained selenium cells with a sensitiveness up to 15 to 1; that is to say, the electrical resistance of his selenium cell decreased in the ratio of 15 to 1 when taken from the dark and placed in the sunlight.

In 1879, Graham Bell and Sumner Tainter engaged in carrying out a number of highly interesting experiments with an apparatus which they called the "photophone." They made the selenium cells by placing small round discs of metal one on top of the other, inserting thin and smaller discs of mica between these and filling the remaining space between the metal discs with selenium. In this case the resistance of a cell, which in the dark was 300 ohms, decreased in sunlight to about 100 to 150 ohms. This comparatively small sensibility was compensated by the low resistance of the cells.

Many designs and constructions of selenium cells have been introduced since then and used in various experiments. As early as 1880 Perry, Shelford-Bidwell and others invented apparatus for transmitting photographs by the aid of selenium cells; while in 1890, Bidwell demonstrated to the London Physical Society the sensitiveness of selenium to light, using an apparatus containing a selenium cell, a sensitive relay and an electric bell.

A strong instantaneous effect is observed at the moment when light first falls upon selenium and the effect gradually increases for some time if the exposure to light is continued.

Professor W. S. Adams found that the exposure of a plate of selenium to the light of an ordinary wax taper at a distance of 20 centimeters diminished its resistance by about one-eighth. Selenium is a very poor conductor of electricity, its resistance being more than a thousand million times that of iron.

The most striking effects are obtained by constructing a selenium cell on the following plan. A strip of mica or some other substance of high insulating power is notched at both edges, and a copper wire is wound around it, leaving alternate notches vacant. Its ends are secured; one being left dead and the other attached to a binding-post. A second wire is then wound in the intervening notches and similarly fastened. This second wire must not touch the first, but should be very close to it. The face of the plate is then thinly covered with selenium, which must be melted on and allowed to cool slowly, being carefully annealed so as to assume the crystalline physical formation. This selenium thus affords the only medium of electrical communication between the two wires. If the two terminal binding-screws are connected to a battery and a high-resistance mirror-galvanometer, the exposure of the

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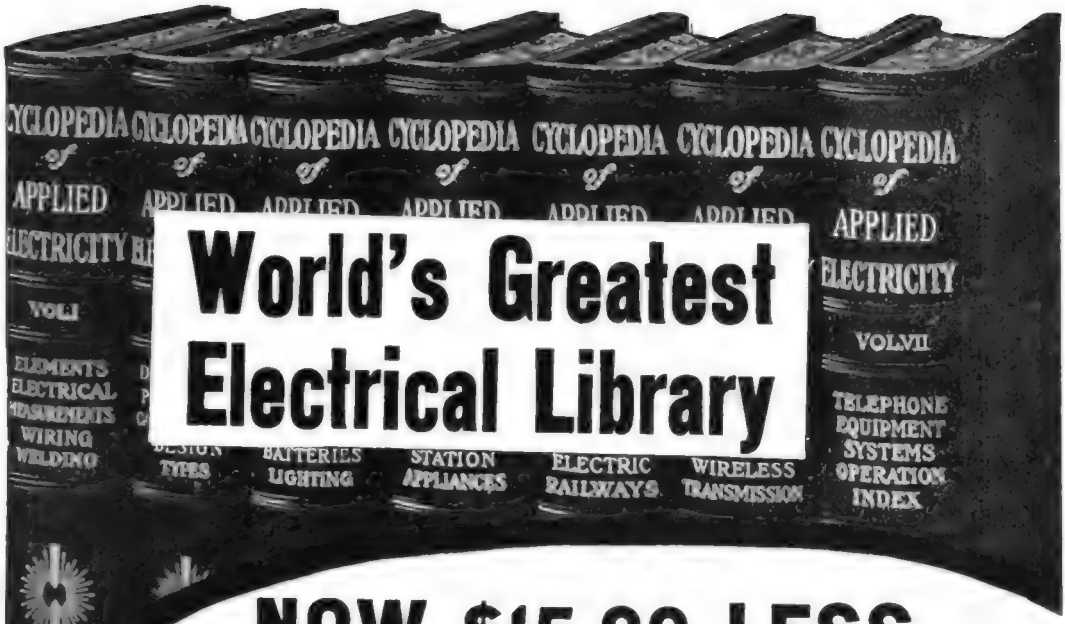

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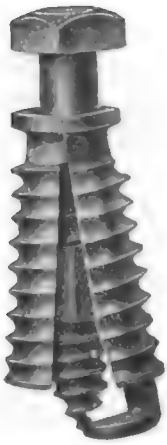

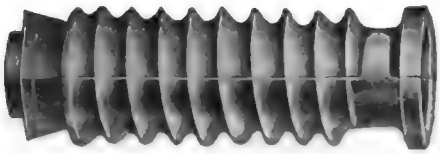

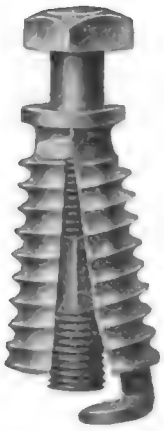

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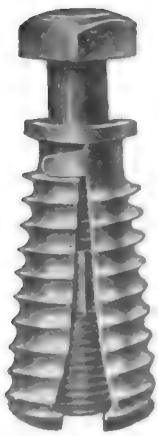

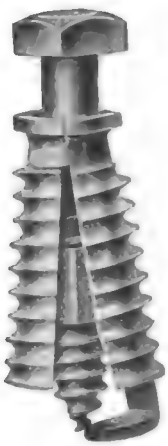

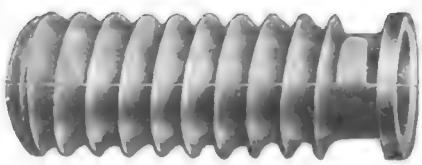

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face of the cell to various degrees of light will indicate strongly marked effects on the galvanometer. If a disc of cardboard is cut away in sectors and rapidly rotated between the face of the cell and the sunlight or any other strong light in such a manner that the cell is alternately in light and shadow as the sectors pass, the fluctuations of current thus produced can be detected by means of a telephone, which will give a very audible hum. This is a very severe test of the quickness of the action, for a thermo-pile gives no sound under the same conditions. This combination of a selenium cell with a telephone is called a "photophone," and with a modified form of it, articulate sounds have been transmitted to a considerable distance by light rays. The invention is due to Professor Graham Bell, the inventor of the telephone, and the form of cell above described was introduced by Mr. Shelford Bidwell.

In the photophone, articulate speech can be transmitted to a considerable distance by the simple agency of a beam of light. Its performance depends not only upon the action of light on crystallized selenium, but also on the fact that a thin plate of glass becomes alternately convex and concave when sound waves fall upon it.

A plate of microscope glass that is silvered in front is fitted into a mouthpiece like that of a telephone, the silvered face facing outwards and constituting the transmitter.

A powerful beam of solar or electric light is directed by a large mirror on the transmitter and is reflected in parallel rays by means of a suitable lens. The rays then fall upon a parabolic mirror at the receiving end and are converged or focused on a selenium cell which is connected in circuit with a battery and telephone.

When the parallel beam of light is concentrated on the selenium cell, the latter will have a definite resistance and no sound will be heard in the telephone. But if the transmitter is spoken into, the microscope glass vibrates, changes its curvature and so causes the beam, which falls on the parabolic mirror, to be alternately diverging and converging. The result is that the quantity of light falling on the selenium

(*Continued on page 204*)

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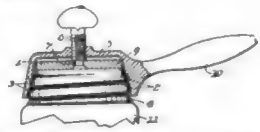
Recent Novel Patents

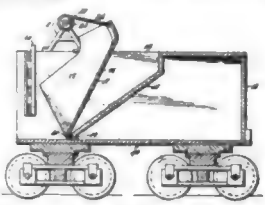
1,061,302. CAN-TOP HOLDER. Gustave Gamels, Detroit, Mich. Filed Nov. 4, 1912. Serial No. 729,515. Renewed Oct. 20, 1913. Serial No. 796,135. (Cl. 46—26.)



1. A can top holder comprising a cup-shaped member having a threaded socket into which a can top may be screwed, a movable plate in the socket of the holder, and means for moving said plate against the can top to jam the threads between the can top and holder to lock the can top thereto.

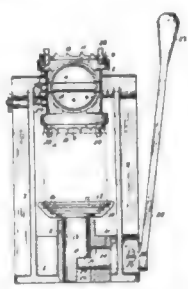
2. A can top holder comprising a cup-shaped member, having a threaded socket thereto to receive a can top, a screw threaded in the top of said holder and passing into said socket, and a movable plate in the socket engaged by said screw.

1,060,969. LOCOMOTIVE-TENDER. James B. Hoag, Scranton, Pa. Filed June 19, 1912. Serial No. 704,617. (Cl. 105—200.)



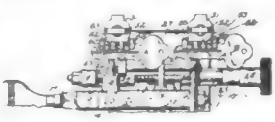
A locomotive tender having a coal pit provided with an opening to permit access to the coal and also having an uninterrupted water compartment at the rear of the coal pit, a fuel-moving member having its lower end pivotally mounted in the coal pit at the bottom of the latter and normally resting against the entire rear wall of the pit, sifted brackets mounted on the top of respective sides of the tender between the front and rear limits of the coal pit, an overhead shaft journaled in said brackets, a connection having one end secured to the shaft and its other end to the upper free end of the member whereby the rotation of the shaft in one direction will move the upper end of the member toward the forward end of the coal pit.

1,060,636. CAN-OPENER. George W. Johnson, Oakland, Cal. Filed Oct. 31, 1912. Serial No. 728,876. (Cl. 30—3.)



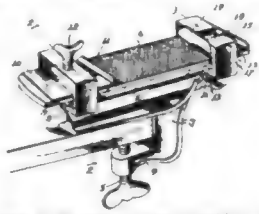
1 In a can opener, the combination with a frame provided with a pair of spaced vertically extending arms, a movable can support carried by said frame and provided with can seats of different diameters for the reception of the cans to be opened, a turret head rotatably carried between the upper ends of said arms, circular cutting knives of different diameters secured to said head and adapted for severing the head from a can adjacent its peripheral edge, means for retaining one of said knives in operative position to the can head to be severed, and an operating lever for moving said can support toward and from said turret head to force the cutting knife carried by the turret head into the can adjacent its peripheral edges and completely sever the same from its body.

1,061,471. KEY-DUPLICATING MACHINE. Harry Tucker, Philadelphia, Pa., assignor of one-half to Philip Kovsky, Philadelphia, Pa. Filed Oct. 29, 1912. Serial No. 728,396. (Cl. 90—13.2.)



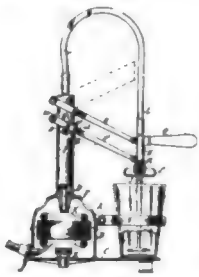
1 In a device of the character described, a standard, a trawer and cutter thereon, key and key-blank holding means slidingly pivoted in the standard a guide member carried by said means, a forked lever slidingly engaged therewith, and spring pressure means engaged with said lever

1,061,606. KNIFE AND SCISSORS SHARPENER. William P. Gray and James H Duncan, Campbellton, New Brunswick, Canada. Filed Apr 30, 1912. Serial No 694,309. (Cl. 76—83.)



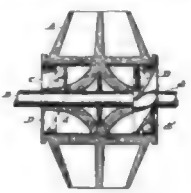
A device for the purposes set forth comprising a supporting body having a flat top, a file resting upon said flat top, a guide plate resting upon the file and having an upstanding flange disposed at an angle to the teeth of the file, a clamping member fitted around the supporting body, the file and the guide plate, and means mounted in said member to secure the file to the support and the guide plate to the file.

1,062,243. MIXING DEVICE. William Gentry Shelton, New York, N. Y. Filed May 8, 1911. Serial No. 626,861. (Cl. 31—43.)



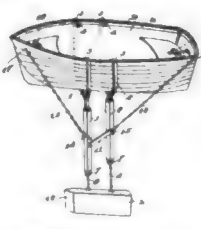
1. In a mixing device or the like, the combination of a stand motor, a movable mixer, a pair of parallel levers for said mixer adapted to guide the same in a substantially vertical direction, and means for transmitting motion from the motor to the mixer.

1,060,656. CENTRIFUGAL PUMP. William K. Richardson, Leavenworth, Kans. Filed Apr 23, 1913. Serial No 763,175. (Cl. 103—42.)



1. In a centrifugal machine, the combination with a rotor adapted to subject fluid to pressure due to centrifugal force, of a plurality of blades in position to deliver fluid into the eye of said rotor and revolve therewith, said blades being inclined toward the rotor in a direction opposite to the direction of rotation, and having a calculated tangentary displacement approximately twice the rated volume designed to pass the mover.

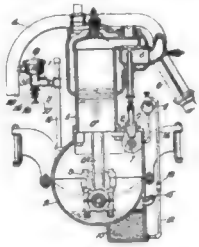
1,062,133 BOAT EQUILIBRATOR. Frank Olschewski, Minneola, N. Y. Filed July 29, 1913. Serial No. 781,963. (Cl. 114—124.)



1. The combination with a boat, of a pair of yokes adjustably secured to the gunwales thereof, an equilibrator flexibly supported by the yokes, and means for raising or lowering the equilibrator.

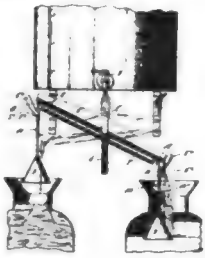
2. The combination with a boat, of a pair of yokes, bars pivotally supported by the yokes, an equilibrator flexibly suspended from the bars, a link connecting the bars a pair of chains one of which is connected to each of the bars, and means for shortening either chain to cause the equilibrator to be brought into juxtaposition either to the stern or the bow portion of the keel of the boat

1,060,716. LUBRICATING-OIL-CONSERVATION ATTACHMENT FOR GAS-ENGINES. Champion Mayfield, Brooking township, Jackson county, Mo. Filed Aug 21, 1911. Serial No. 645,086. (Cl. 123—196.)



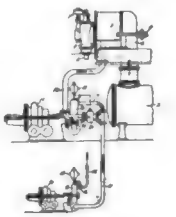
1. The combination with a gas engine, of a connection establishing communication between the crank case and the intake pipe of the engine, and means whereby the capacity of the said connection is caused to vary inversely as the speed of the motor.

1,061,862. MILK-CAN FILLER. Charles Arthur Patton, Villa Ridge, Mo. Filed Aug. 17, 1912. Serial No 715,687. (Cl. 226—13.)



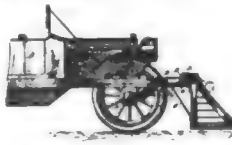
1. The improved milk can filler, comprising a rockable filling spout pivotally mounted, float adapted to rock said spout during the operation of filling milk cans, float stems telescopically adjustable in length and connecting said floats to said rockable filling spout, a guard at the end of said spout, means for securing said guard to one of said float-stems, a cylindrical weight-container connected to the under side of said rockable spout and extending longitudinally thereof to a point adjacent the ends of said spout, and a suitable movable weight within said weight-container.

1,061,367. TURBINE SYSTEM. Walter Kirsch, Berlin, Germany, assignor to General Electric Company, a Corporation of New York. Filed Jan. 13, 1909. Serial No 472,062. (Cl. 121—58.)



1. In combination, a main turbine, auxiliary turbines, a conduit means supplying motive fluid to the auxiliary turbines in series and conveying the exhaust therefrom into the main turbine at an intermediate pressure region, and a regulator for one of said auxiliary turbines which changes the pressure difference to which another of said auxiliary turbines is subjected

1,062,418. AUTOMOBILE-FENDER. Julius Dreschsler, Camden, S. C., assignor of one-fourth to Legrel A. Witthowsky, Camden, S. C. Filed Sept. 10, 1913. Serial No. 789,063. (Cl. 105—264.)



1 The combination with an axle, of a frame connected thereto, a fender pivotally connected to the frame, a gear wheel connected to the fender, and a rack bar meshing with the gear wheel for the purpose of oscillating the fender

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Recent Novel Patents

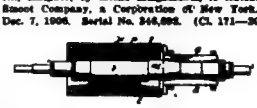
1,081,160. MULTIPLE-FUSE DEVICE. GEORGE S SHOUPE and WILLIAM H. PALMER, Cleveland, Ohio. Filed Dec. 20, 1912. Serial No. 737,880. (Cl. 175—275.)

1. In a multiple fuse device, a body, fusible elements disposed at the opposite sides of said body, a binding post common to said fusible elements, a contact, means holding said contact for sliding movement, a second binding post, electrical connections between said last-named post and sliding contact, trip levers pivoted to the opposite sides of said body and staggered relatively to one another and each having one end connected to the free end of one of said fusible elements, and the opposite end disposed in the path of movement of said contact whereby the fusible elements may be placed in circuit successively as the same become burned out or ruptured, and means for sliding said contacts.

1,080,563. ELECTRIC SWITCH. OTTO M. KNOBLOCK, South Bend, Ind. Filed July 11, 1912. Serial No. 708,747. (Cl. 175—282.)

1. A switch, comprising a base having a grooved upper portion and a lower portion, the bottom of said grooves being above the surface of said lower portion, contact plates seated in said grooves and projecting over said lower portion, means for securing said plates in said grooves, a blade pivoted on one of said securing means between one of said plates and said lower portion, and a boss on the lower portion whose top surface lies in a plane lower than the bottom of said grooves and in alinement with one of the plates for forcing said blade into engagement therewith.

1,080,611. LAMINATED CORE FOR ELECTRIC GENERATORS AND MOTORS. ERNST H. WAIT, Chicago, Ill., assignor, by mesne assignments, to Ralcon Battu Smoot Company, a Corporation of New York. Filed Dec. 7, 1909. Serial No. 532,892. (Cl. 171—208.)



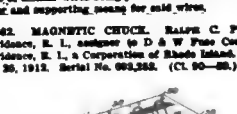
1. A core for electrical machines built up of iron laminations and plates of copper interspersed between said iron laminations, and a winding on said core, said copper plates projecting beyond the exterior surface of the core and its windings so as to form salient flanges adapted to dissipate heat.

1,081,865. THERMOPILE. WILLIAM W. COBLENTZ, Washington, D. C. Filed Oct. 26, 1912. Serial No. 727,912. (Dedicated to the public.) (Cl. 171—78.)

1. In a thermal generator, a shield provided with an aperture, a series of thermal elements supported behind said shield, said thermal elements being joined to form hot junctures and cold junctures, receivers of heat conducting material joined to said elements at the hot junctures, said receivers being overlapped to form an opaque curtain arranged behind said aperture.

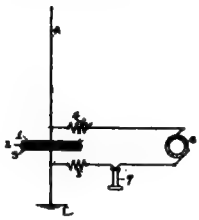
2. In a thermal generator, a plurality of receivers, wires of dissimilar metals joined to said receivers, a plurality of ends of similar wires being joined near the ends of each receiver and supporting means for said wires.

1,081,462. MAGNETIC CHUCK. RALPH C. PATTON, Providence, R. I., assignor to D & W Fuse Company, Providence, R. I., a Corporation of Rhode Island. Filed Apr. 26, 1912. Serial No. 693,253. (Cl. 90—59.)



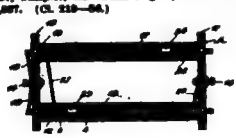
1. In a magnetic chuck, the combination of a magnetizing coil and a core for the same, one end of which is provided with a plurality of pole-projections the faces of which are arranged parallel with each other and transversely of and at acute angles with the longest dimension of said core.

1,080,544. WIRELESS SIGNALING SYSTEM. CORNELIUS D. EHRET, Ardmore, Pa. Filed Dec. 7, 1908. Serial No. 466,228. (Cl. 250—20.)



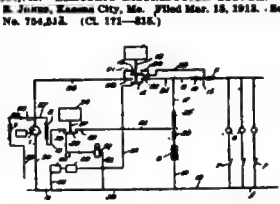
1. In a wireless signaling system, receiving apparatus comprising a condenser wave responsive device, a receiving conductor or circuit associated therewith, a source of fluctuating current in a local circuit including said wave responsive device, and means responsive to changes in said fluctuating current for producing a signal.

1,080,608. INDUCTANCE-COIL. FRANKLIN G. THAYER-HART, Tompkins, Ill. Filed Aug. 7, 1912. Serial No. 713,607. (Cl. 219—56.)



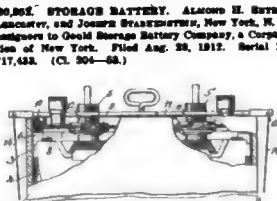
In a device of the class described, a non-conducting frame including end members and core members connecting said end members, binding posts carried by said end members respectively, metallic rods connecting the end members and disposed above respective core members, an insulated wire having one end connected to one of said binding posts and then coiled about said core members successively, the insulation of the coils disposed beneath respective rods being removed to expose the wire, sleeves slidably mounted on each of said rods, contact fingers carried by the sleeves respectively, each of said fingers being U-shaped and having its outer arm extending substantially parallel to the adjacent coil and engaging the exposed portion of the latter throughout the greater portion of the extent of said arm and having its side edges in engagement with the walls formed by the adjacent removed portion of the insulation.

1,081,748. ELECTRIC DISTRIBUTION SYSTEM. LEE E. JOSEPH, Kansas City, Mo. Filed Mar. 18, 1913. Serial No. 754,513. (Cl. 171—318.)



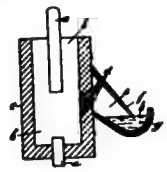
1. In an electric distribution system, the combination with a generating unit comprising a dynamo electric machine and prime mover, and distributing mains, of a storage battery, a relay for connecting the same to the dynamo electric machine for the purpose of running the same as a motor for starting purposes, and a connection between the relay and a distributing main for the purpose of energizing the relay with current which flows between the distributing mains when a circuit is closed between the distributing mains, substantially as described.

1,080,802. STORAGE BATTERY. ALONZO H. BETTES, Lancaster, and JOSEPH STARKWEATHER, New York, N. Y., assignors to Gould Storage Battery Company, a Corporation of New York. Filed Aug. 28, 1912. Serial No. 717,433. (Cl. 204—58.)



1. The combination with a storage battery jar, battery plates and terminals extending up therefrom, of a right bar extending across the top of the jar and provided with openings for receiving the terminals from the plates, means for detachably securing the bar to the terminals, and a detachable sling extending from the ends of the bar around beneath the jar, whereby the plates may be lifted out of the jar or the whole jar lifted, depending upon whether the sling is secured to the cross bar.

1,081,912. SMELTING-FURNACE. KARL OSKAR EMIL OLSSONER, Trollhättan, Sweden, assignor to Trollhättans Elektrotermiska Aktiebolag, Stockholm, Sweden. Filed Sept. 6, 1911. Serial No. 647,696. (Cl. 204—64.)

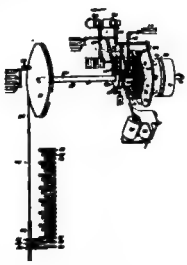


1. In an electric furnace in combination with the smelting chamber, electrodes for supplying an electric current to the charge within the said smelting chamber, a condensing chamber arranged outside the furnace, and a single means for conducting gases, evolved during the reduction of the ore, to the condensing chamber, in which the ore condensable gases are separated from the non-condensable gases owing to the difference in their specific weights, and reconducting non-condensable gases from the condensing chamber to the furnace.

1,081,884. ATTACHMENT-PLUG. ALBERT M. BRADLEY, Napoleon, Ohio. Filed Mar. 13, 1913. Serial No. 754,117. (Cl. 173—304.)

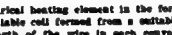
1. An attachment plug, including a body of insulation having a gripping portion provided with oppositely disposed grooves, a socket contact member carried by the body and having two oppositely disposed sections, a spring within the socket and holding the free ends of the sections extended, and two finger blocks connected one to the terminal of each section and slidably mounted in the grooves for collapsing the sections, said blocks being extended by the sections when released.

1,081,908. SELECTOR MECHANISM. EDWARD E. CRAFT and ANSON F. DYSON, New York, N. Y., assignors to Western Electric Company, Chicago, Ill., a Corporation of Illinois. Filed Jan. 11, 1908. Serial No. 410,330. (Cl. 179—27.5.)



1. In a selector switch controlling device, the combination with a plurality of relatively adjustable controller members, of a part having relative movement with respect to said controller members, and stop means brought into action by the mechanical conformation of said relatively-movable part with said controller members jointly, according to their adjustment.

1,081,414. ELECTRIC HEATING ELEMENT. ALONZO A. WARNER, New Britain, Conn., assignor to Landers, Frary & Clark, New Britain, Conn., a Corporation of Connecticut. Filed May 6, 1913. Serial No. 766,510. (Cl. 219—71.)



1. An electrical heating element in the form of a self-supporting pliable coil formed from a suitable resistance wire, the length of the wire in each convolution being greater than the circumference of the convolution.

2. An electrical heating element in the form of a self-supporting pliable compound coil, the convolutions of the major coil being out of contact.

3. An electrical heating element in the form of a self-supporting pliable compound coil, the adjacent convolutions of the minor coil having points of contact with one another, and those of the major coil being out of contact.

4. The herein described method of forming an electrical heating element which consists, first in forming a strand of resistance material into a closed coil with its convolutions in contact, and second in winding this coil about a temporary mandrel into a second coil whose convolutions are out of contact, the first coil being subjected to a slight tension while being wound into the second coil in order to open up the outer parts of its convolutions.

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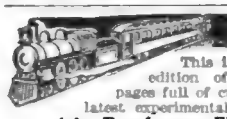

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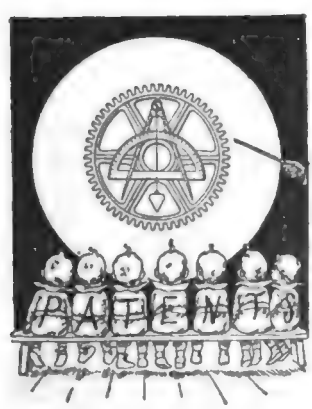

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SELENIUM AND SELENIUM CELLS

(*Continued from page* 196)

is constantly varying with the words spoken into the transmitter.

In addition to the type of selenium cell previously described, a second type of cylindrical shape with solid porcelain core has been manufactured by a Berlin electrician who, by the aid of his cylindrical cells and an up-to-date system of wireless telephony by light, succeeded in speaking over a distance of several nautical miles.

The above two types of selenium cells are manufactured with solid cores, and thus possess the disadvantage of being exposed to the light on one surface only and the resulting loss of efficiency can only be overcome by using selenium cells without any core. The manufacture of such cells involved considerable difficulties, but a London electrician, after much experimenting, succeeded in devising three types of selenium cells which are exposed to light on both surfaces.

The sensitivity of a selenium cell is thus increased fully 75 per cent., and the change of resistance takes place to the full extent almost immediately. The cells are manufactured in flat, cylindrical and conical forms, and do not differ much in sensitiveness. Each can be employed for ordinary experiments where the highest efficiency is required. It is advisable, however, to choose the most suitable form.

The flat selenium cells, having large plain surfaces, work most satisfactorily in diffused light, while the cylindrical and conical cells show certain advantages when fixed in the focus of a concentrating lens or a parabolic mirror.

The resistance of these selenium cells ranges from 2,000 to 60,000 ohms. They vary in sensitiveness from 4:1 to 15:1; that is, the resistance of a good selenium cell decreases in the ratio of 15 to 1 when taken from the dark and exposed to bright sunlight. The electromotive force to be used with these cells varies for different experiments from 2 to 60 volts and the current should not exceed 0.03 amperes. This comparatively low amperage is quite sufficient

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to actuate a sensitive galvanometer or a telephone receiver, so that either one can be inserted directly in the circuit of the selenium cell and battery. If it is desired to operate apparatus requiring a stronger current, it must be worked through the agency of a sensitive relay. The selenium cells with plain surfaces are manufactured as devised by Siemens. Two thin wires are formed into flat spirals, and carefully placed on a small disc of mica. A thin sheet of crystalline selenium is placed on top, and the whole is put under slight pressure. This arrangement is heated to about 220 degrees Centigrade, when the melting selenium slowly fills the narrow space between the two wires.

After cooling the cell is placed in a paraffin bath and slowly heated to about 180 or 200 degrees Centigrade, when the selenium again assumes its "crystalline" condition. To show its sensitiveness to light, the cell can either be inserted in a circuit comprising a battery and sensitive galvanometer, or can be put in the circuit of a Wheatstone Bridge. The resistance of these cells varies between 2,000 to 10,000 ohms and will drop in the ratio of 6:1 or 8:1 when the cell is exposed to bright sunlight. The diameter of these cells ranges from one inch to two and one-half inches.

The "Photo-microphone" is an apparatus used for transmitting speech by the aid of light. This apparatus consists of a highly sensitive selenium cell, a manometric capsule with acetylene burner, a large concave mirror on an iron stand and an acetylene generator. The selenium cell is connected with a battery of nine dry cells and two telephone receivers. It faces the small acetylene flame which is fed by the generator. The acetylene gas flows through the manometric capsule which is provided with a large membrane of mica and a speaking tube. Speaking against the membrane will result in corresponding vibrations of the small acetylene flame, which will, therefore, continually alter its intensity. These vibrations of the flame can be observed in a rotating mirror.

The selenium cell being thus illuminated, its electrical resistance continually alters and the oscillations of the

(*Continued on page 227*)

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BOOK REVIEWS

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INSTRUCTIONS IN PRINTING

A course in modern printing has recently been published under the title of "Practical Typography" in which many features serve to highly recommend the work for use in schools.

"Practical Typography"* is published in the form of a loose-leaf book with a durable paper cover. The various sheets may be removed for the further convenience of the student in practicing the exercises. The contents are arranged in the form of instructions and also as "copy" for exercises, so that the student can set up the type and at the same time be taught certain information pertaining to the subject of which the exercise is an example.

The book covers the subject of printing thoroughly, beginning with a treatise on correct spacing and finishing with the making up of a book. The author's long experience, not only as a practical printer but also as a teacher of printing, is strongly in evidence throughout the work. All the instructions represent the highest standards of modern printing, and will enable the student to become an expert compositor capable of handling the most difficult composition.

Although the work is, of course, primarily intended for the apprentice in printing, it contains a mass of information that should be invaluable to many skilled printers. The suggestions on improved typographical arrangements; the tables relating to the number of ems contained in a pound of type, standard book sizes, sizes of flat writing paper, standard sizes of ruled paper, standard envelope sizes, number of words to an inch, number of leads to a pound, standard book measurements, sizes and weights of paper, standard sizes of cut boards, and amount of paper required for a job; as well as many other similar features will appeal to even the master printer, advertising man, book publisher and anyone else interested in modern printing.

* *Practical Typography*, by Geo. E. McClellan. Published by The Manual Arts Press, Peoria, Ill. Contains 63 exercises and the necessary instructions. Durable paper cover. Price, $1.50.

WIRELESS TELEGRAPHY

One of the most recent additions to the Cambridge Manuals of Science and Literature is a short work on wireless telegraphy, prepared by Mr. C. L. Fortescue, M. A., Professor of Physics, Royal Naval College, Greenwich, England.

This book, "Wireless Telegraphy,"* has been written by the author with the view of explaining in as simple a manner as possible the workings of a modern wireless station, as well as the principles involved in this marvelous system of communication. Although the subject of wireless telegraphy is necessarily a highly technical one, the author has made the explanations simple enough for any reader possessing only a general scientific knowledge to thoroughly understand them. No attempt is made to delve deep into the subject; the book being intended solely for the layman.

The first few chapters are devoted to explanations of the phenomena involved in wireless transmission and reception, and as far as possible the author has given most excellent mechanical analogies. Two chapters are devoted to the application of the principles in actual wireless communication. The balance of the book describes the uses of wireless telegraphy on board ships, the use of wireless telegraphy between fixed stations over land and sea, the employment of this means of communication for naval and military purposes, and, lastly, a short treatise on wireless telephony.

This work is highly recommended to the beginner or anyone desiring a general knowledge of wireless telegraphy, and is a worthy addition indeed to the Cambridge Manuals of Science and Literature.

* *Wireless Telegraphy*, by C. L. Fortescue, M.A. Published by the Cambridge University Press, London. For sale by G. P. Putnam's Sons, New York City. Contains 148 pages and 20 illustrations. Cloth bound. Price, $0.40.

PATENTS AND TRADE MARKS

Inventors, investors and manufacturers, interested in the development of new ideas will welcome the work of Mr. Henry C. Thomson entitled "Patents, Trade-Marks and Design Patents" in which authentic information regarding these subjects is given in simple and readily understood language. The author's experience as a patent attorney and general patent expert has eminently qualified him to prepare such a work in a compact form.

"Patents, Trade-Marks and Design Patents"* covers all the phases involved in the developing of new ideas. It informs the reader on the judicial aspects of patented inventions, the financing of patent enterprises, and every other topic connected with the patenting of an invention and the litigation which may ensue in the struggle that follows for commercial supremacy. The author discusses claims and disclaimers, infringement and injunctions, copyrights, prints and labels, and damages and profits. In each case the discussion is enhanced by the quoting of the important points that have been brought up in court cases. In order to make the work more intelligible, the author has arranged it in question and answer form throughout, and has avoided the use of any confusing legal expressions.

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This book should be in the hands of those who are interested in new inventions, whether they be inventors, investors or manufacturers of patented specialties.

* *Patents, Trade-Marks and Design Patents,* by Henry C. Thomson. Published by The Bellevue Publishing Company, Boston, Mass. Leather covered. Price, $5.00.

A BOOK ON SWITCHBOARDS AND PROTECTIVE APPARATUS

Under the title of "Switchboards, Switching and Protective Apparatus,"* Mr. C. C. Adams, B. S., Switchboard Engineer for the General Electric Company, has prepared an interesting and complete work on modern switchboard practice. The author is indeed well qualified to write upon the subject he has chosen, having been engaged for several years in solving switchboard problems for one of the largest electrical companies in the United States.

The book opens with an introduction in which the functions of the switchboard are explained to the reader. Following, is a description of the various forms of switchboards as well as a table of switchboard diagram symbols. The work then goes on with instructions regarding the different arrangement of instruments for diversified purposes, and also a brief description of the different component parts and instruments that go to make a switchboard. The text is written from a practical man's point of view, the author evidently having endeavored, in preparing the work, to furnish an instructive guide for the electrical engineer and electrician actively engaged in switchboard construction or operation.

"Switchboard, Switching and Protective Apparatus" is exceedingly well illustrated, not alone with diagrams and drawings, but with photographic views of the switchboards and instruments.

* *Switchboard, Switching and Protective Apparatus,* by C. C. Adams, B.S. Published by American School of Correspondence, Chicago, Ill. Contains 119 pages and 72 illustrations. Cloth bound. Price, $1.00.

INSTRUCTIONS IN DRAFTING

Under the title of "Drafting Room Series,"* an interesting collection of instructive charts and text books has been published for vocational schools, evening schools, technical schools and engineering students.

The series consists of text books divided into three separate parts—Part 1, Reading Machine Drawings; Part 2, Machine Drafting; and Part 3, Interference of Moving Parts and Tooth Gears. There are also 54 instruction plates printed on stiff, white cardboard. The entire series is contained in an attractive cloth filing box on which the title is printed in gilt. The top of the filing box may be used as an easel when the cards are being studied.

The entire work has been treated by the author from an unique viewpoint. The in-

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structions on machine drawing are the result of a new analysis of the processes of commercial drafting by one that is a practical draftsman, engineer and teacher. A striking feature of the text books is that the author has refrained from choosing merely difficult and time-consuming problems, but instead has selected problems that present certain principles. The aim has been to develop skill, not through repetition, but through understanding. In all, the series forms a very commendable course in drafting for anyone desirous of learning or attaining increased skill in the art.

* *Drafting Room Series*, by Frederick H. Evans, M.E. Published by The Manual Arts Press, Peoria, Ill. Contains three text books and 54 instruction plates in a cloth-covered filing box. Price, complete, $2.00. The three parts are offered separately, viz.: Part 1, $0.75; Part 2, $1.25 and Part 3, $0.90. The foregoing prices include the filing box. If the box is not desired, $0.25 may be deducted from these prices.

MODERN ELECTRIC WIRING

Probably no better book could be found for the practical electrician than the recently published book entitled "Electric Light and Motor Wiring,"* which is of the conventional vest-pocket size.

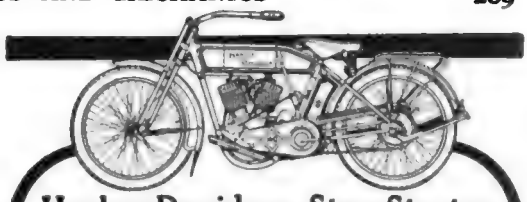
The work opens with a discussion on the various forms of circuits as well as the difference between, and the characteristics of, alternating and direct currents. In the treatment of each subject, the Underwriters' point of view is closely adhered to. Then follows instructions in condensed form on the various points that the electrician is confronted with in every-day wiring for motors and lights. The materials required; method of wiring for different dwellings, stores and factories; the installation of fixtures; cut-outs; the Underwriters' requirements for each instance; and invaluable tables and formulæ are only a few of the many subjects covered by the book. Although there are almost innumerable works on elementary electricity as well as advanced electrical engineering in all its branches, this little volume covers a field that has strangely been neglected. It is a practical book for the practical electrician and it will prove a useful addition to any electrical library.

* *Electric Light and Motor Wiring*, by Geo. J. Kirchgasser. Published by Electroforce Publishing Co., 161-171 Michigan St., Milwaukee, Wis. Contains 270 pages and 142 illustrations. Leather cover. Vest-pocket size. Price, $1.00.

A REDUCTION IN PRICE

Owing to the large number of copies printed of the second edition of "Experimental Wireless Station" by Philip E. Edelman, the price has been reduced from $2.00 to $1.50.

The wireless articles in this issue should prove of considerable interest to those readers who are interested in radio communication. The contribution describing the construction of a rotary tuning transformer is profusely illustrated and thoroughly explained. The article regarding the *Tarragon* is of timely interest, since it deals with another means Uncle Sam has inaugurated to enforce the wireless laws.



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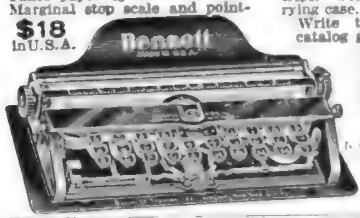

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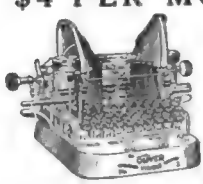

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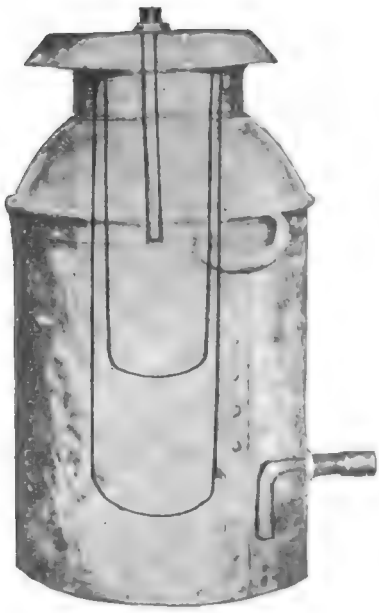
NEW THINGS

Electrical—Wireless—Mechanical

A COMBINATION BLOWING AND VACUUM OUTFIT

A ROTARY VACUUM PUMP

There are many owners of shops, factories or laboratories that would not hesitate to install a vacuum cleaning outfit were it not for the prevailing wrong impression that such an equipment involves considerable expense. Everyone realizes the advantages of a vacuum system of cleaning for either the home or the place of business. But the manufacturer is in a particularly good position to derive the greatest benefit from such an outfit, not only on account of the cleanliness that can be effected in the plant and office, but also from the fact that the outfit can be used for a wide diversity of other work in the establishment.



A SIMPLE SEPARATOR TANK

In connection with most vacuum cleaning outfits, there is generally supplied a rotary vacuum pump such as that manufactured by Leiman Bros., 62 John street, New York City. This particular vacuum pump is not only limited to its use as a suction pump, but can also be employed as a blower in connection with sandblasts, gas furnaces, blowpipes, agitation, etc., as well as many other uses such as cleaning dust and dirt out of intricate parts of machinery, electric motors, and other similar equipment. This pump can also be used for melting, brazing, annealing, etc.

Anyone can make a vacuum cleaning plant without any expensive equipment other than a vacuum pump. In the accompanying illustration is shown a simple separating tank that can be readily constructed from an ordinary 40-quart milk can which can be procured at the expense of a few dollars. The cover of this can forms an air-tight tank and is therefore especially adapted for this work. A round hole is cut in the cover and a pipe connection made as shown in detail in the sketch. The pipe or hose connecting the tank with the cleaning tool is attached at this point. The connection from the can to the pump is made at the bottom in a similar manner. This can is to act as a screen to prevent the dust and dirt from entering the pump and it is therefore necessary to provide a screen in the can to catch the dust and dirt. This is accomplished by means of a bag made in a suitable shape to set into the can about three-fourths of the way down, and to rest over the neck of the can in such a manner that the cover will be drawn down over the top, holding it secure. This bag may be made of some suitable material such as canvas, canton flannel, or silk bolting cloth, depending on the amount of dirt and dust to be removed. The connection to the pump is made by means of a pipe nipple and union. The machine is now ready for operation after attaching a belt to the pump from a motor or a line of shafting.

By following the simple directions given in the foregoing paragraphs, anyone possessing an ordinary mechanical ability can install a complete vacuum cleaning outfit at a minimum cost—the only appreciable expense being the cost of the rotary pump. Aside from its use as a vacuum cleaner, such an equipment may be used for a large number of purposes already mentioned.

A WIRELESS TESTING STATION

The firm of C. Brandes, Inc., has recently installed in its new offices at No. 1 Liberty street, New York City, an elaborate showroom for the sale of standard wireless receiving apparatus from the best manufacturers in the country, as well as for demonstrating its high grade line of wireless receivers.

In connection with this showroom, the firm has erected a large aerial on the roof of the building—a 20-story modern skyscraper—for the testing of wireless instruments and receivers. The aerial is over 350 feet high and about 100 feet long. It is of the looped type and comprises four wires mounted on eight-foot spreaders; the wires being brought down from both ends to a point on the roof half way between the extreme ends. In all, the aerial is over 250 feet long.

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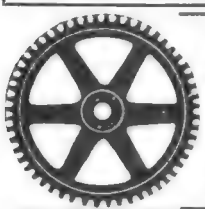

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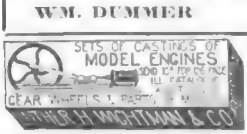

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All the wireless apparatus and telephone receivers handled by C. Brandes, Inc., are displayed in a well lighted showcase, and a testing table is provided for enabling customers to determine the merits of the various articles the firm has for sale. Wireless operators and experimenters are extended a cordial welcome to visit the offices of the firm at any time.

AN IDEAL TELEGRAPH SCHOOL

The writer recently made a trip to Boston, the home of schools and colleges, to look up and investigate private schools of various kinds, for a friend.

A SCENE IN THE BOSTON SCHOOL OF TELEGRAPHY

Among the hundreds of such places—each specializing in some one profession or industry—I was delighted to find a model school whose specialty is instructing the students in all branches of Telegraphy; Railroad, Commercial and Wireless being the most important.

This institution is known as the Boston School of Telegraphy, and as a great many persons are interested in this subject, I will give a brief outline of what I found out about it during my investigations.

For the first thing, I was struck by the ideal location for a school of this type. Located at 18 Boylston street, it is within easy access of both the North and South Stations, subway, tunnel and surface lines from all parts of the city and suburbs.

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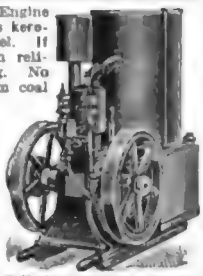

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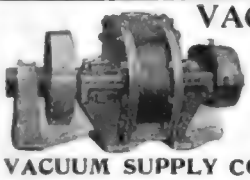

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for cleaners at wholesale. Electric or gasoline power. For stationary house or flat machine or wagon outfit. Our pumps rugged, will stand any wear. Assemble your own machine. Saves half. Dept. E.

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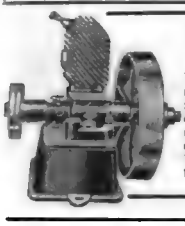

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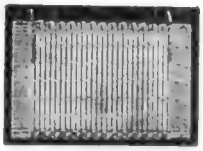

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AND

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Electric Flashlight Pistol

Complete with **two** batteries and tungsten light. Gun metal finish, handy to carry, never in the way. Size 3x3½. It's no toy but a neat, handy flashlight. Protect yourself in the dark.

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Complete with emery wheel, buff wheel, pulley to run sewing and washing machine, polish. In some cities where we have no agents, and where the water pressure is good, a **sample motor** will be given **free**; apply at once if you want to make some extra money, or if you can devote your whole time, liberal salary and commission will be paid. **$2.50**

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ENGINEERS WANTED to send for catalog of indicators. Reducing Wheels Planimeters. Address

LIPPINCOTT M. S. CO.

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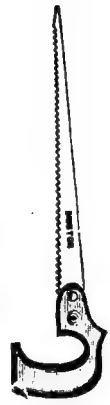
The Economy of Good Tools

is a fact so well known that you do not need to be reminded of it. The only problem in your mind is what tools best represent true economy. It is a problem of easy solution, for

DISSTON BRAND GOODS

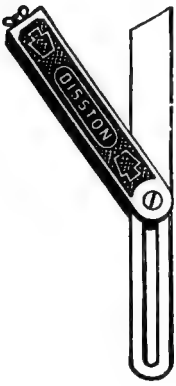
(Quality Guaranteed)



have withstood the hardest test of all—the test of time.

Aside from the long record of Disston Saws, covering several generations, you will find that nearly every Disston tool, embracing trowels, plumb and levels, try squares, bevels, screw drivers, etc., has an efficiency record of anywhere from 25 to 50 years or longer. During those periods of their manufacture the demand has steadily increased, and is increasing more than ever today. True economy in tool-buying means looking for the Disston name and trademark.

Send five 2-cent stamps for DISSTON HANDBOOK —tells how to set and file saws



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Incorporated

Keystone Saw, Tool, Steel and File Works

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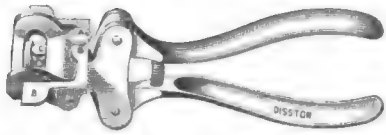

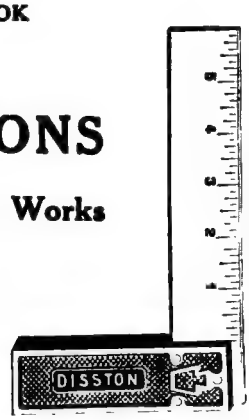

When writing, please mention "Modern Electrics and Mechanics."

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shown more courteous and kind attention. Everything was explained in a clear, concise way.

The students enter for a period ranging from three to six months, at a nominal cost of from twelve to fifteen dollars per month according to the branch of telegraphy they are desirous of learning. The classes study in light, pleasant rooms where they work about five hours a day. Each student has individual work so that he or she can proceed as rapidly as possible and cannot be retarded by others in the class who are apt to be somewhat slower.

I was greatly fascinated with the wireless station, which, I was informed, was constructed with a great regard for details at a cost of nearly $4,000. Instruction in this branch includes practice with all the systems used today so that upon graduating a student may secure work with any company, anywhere.

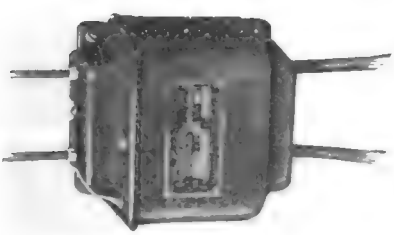
Another interesting fact brought to light was that with hardly an exception, all the graduates in the past few years were able to secure employment readily, and, what is better still, to hold their positions.

On leaving I was presented with their catalog, a neat book written in a clear, comprehensible manner, which on reading later proved to be without a mis-statement. These catalogs are mailed on request to all who are interested in telegraphy or those that are desirous of learning some profession or other and are still undecided.

In closing, I would state that anyone desirous of securing a thorough training in any branch of Telegraphy will do well to write to the Boston School of Telegraphy, 18 Boylston street, Boston, Mass., for the literature of that institution.

TRANSFORMERS FOR ALL PURPOSES

Among the many products of the Packard Electric Company is a complete line of transformers for all purposes.



BELL RINGING TRANSFORMER

One of the most popular products of this firm is a closed core wireless transformer that

HEALTH POWER AND VIGOR WITHIN YOUR GRASP

80% of every population are only **"half alive."** How about yourself? Are you suffering from any form of disease? If so, stop and investigate

Oxydonor

This wonderful instrument has been tested in thousands of cases of disease of every name for the past twenty-three years and today stands on its merits. We court the severest investigation. Many of the best families throughout the World are using OXYDONOR exclusive of all drugs and medicine.

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made by Jos. Hancock, Lamoni, Iowa. Schearer, Montana, made *$22.35 in 5 hours.* Miller, Iowa, Made $13.65 in one afternoon. *We have proof* of this and hundreds of similar reports. No matter who you are or where you live, here's your chance to double your present salary or income, working during spare time or permanently as a *one minute photographer. No experience needed.* A new, live business of big cash profits. You can work at home or travel, enjoy the healthful, outdoor work and become independent in your own business. Invest one cent for a postal—ask us for proof of what others are doing—of what you can earn with a

Mandel Post Card Machine

A portable post card gallery. Takes, finishes and delivers photo post cards and buttons in a minute's time—makes five different styles of pictures in 3 sizes. No plates, films or darkroom. One minute pictures sell like wildfire. Everybody buys. Picnics, fairs, carnivals, busy corners, small towns and large cities—Big Money Everywhere.

This Picture-Taking Outfit

gives you a complete, ready made business that produces profits for you at once. You can make 100 to 200 sales a day, easy. Each sale brings 8c to 16c clear profit. Small capital. Sale of first supplies brings back practically your entire investment. Write at once for full particulars FREE.

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Will You Accept $75 A Week?

Yes!—You'll make that and more, easily, if you start at once with

Diamond Post Card Gun

A new invention—takes official size post cards and photo buttons, 4 sizes, without films, plates or darkroom. Turns out 5 to 8 a minute—you net 8c. profit on every click of the bulb.

Positively No Experience Needed

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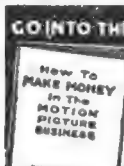

YOU CANNOT BEAT IT FOR MAKING BIG MONEY QUICK

Send For this Book—it tells how you can start with a small capital, explains everything pertaining to the business and how to conduct it profitably, illustrates and describes the proper machines and outfits to use. It's a regular guide for anyone contemplating engaging in this big money-making business, or who want to buy machines, film, accessories, etc., on the payment plan. Sent free upon request.

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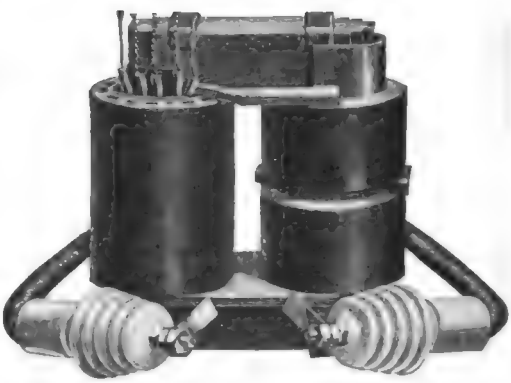
is said to contain over 30,000 turns of wire. It is rated as a 13,200 volt transformer and has a capacity of almost one-half kilowatt; the primary being capable of drawing four amperes without injury. A novel feature of this transformer is its high voltage, which permits of using it with a very small condenser so as to secure the maximum efficiency with the short wave lengths to which the amateur is now restricted since the wireless laws became effective. The transformer is sold complete, ready to be placed in a suitable case, for $9.00.

The Packard Electric Company also manufactures lighting and power transformers that possess many improvements. These transformers are provided with four ventilating ducts in the yokes, which communicate with channels inside the windings and insure a supply of cool oil where it is most needed. A special type of core is used which equalizes the magnetic density in all parts and insures against cross-magnetization.

Another product of the firm that has proven exceedingly popular is the A-W Regulator which is of new design and intended for series lighting circuits. It has now been on the market for about four years and has proven highly satisfactory. It has no floating coils or moving parts whatever, and therefore operates instantaneously to compensate for lamp trouble and short circuits.



COMPLETELY ASSEMBLED WIRELESS TRANSFORMER

A complete line of bulletins describing all the various Packard products has just been printed and will be gladly furnished to anyone addressing the Packard Electric Company, Warren, Ohio.

AN IMPROVED AUTOMATIC TELEGRAPH TRANSMITTER

Dodge's Telegraph, Wireless and Railway Institute of Valparaiso, Ind., one of the best known schools of its kind in the United States, has recently perfected an automatic transmitter that sends signals of a similar nature to those of a wireless station.

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Never mind how STRONG You are

What d'ye KNOW?

THAT'S the point—"What d'ye KNOW?" Today it's a battle of wits—and *brains win*. Muscle and brawn don't count so much as they used to.

In the conquest for good jobs and big salaries it's *brains*—not brawn—that win the day. "What d'ye KNOW?" is the one great question that draws the line between defeat and victory—between "wages" and "salary"—between *you* and the *Boss*.

What do *YOU* know? Are *YOU* so expert in some line of work that you can "make good" as a foreman, superintendent, or manager? If not, why don't you mark and mail the attached coupon and permit the International Correspondence Schools to show you how you *CAN* "make good" on a big job.

For more than 21 years the I.C.S. have been showing men how to do better work and earn bigger salaries. Every month over 400 students write of promotions or salary increases through I.C.S. training. What the I.C.S. are doing for these men they can do for *YOU*.

No matter where you live, how old you are, what hours you work, or how limited your education—if you can read and write and are ambitious to learn—the I.C.S. can train you in your own home, during your spare time, for a more important and better-paying position.

Mark and mail the attached coupon—it won't obligate you in the least—and the I.C.S. will show you how you can acquire this salary-raising ability by their simple and easy methods.

It will cost you *nothing* to investigate—it *may* cost a lifetime of remorse if you don't.

Mark and Mail the Coupon TODAY

INTERNATIONAL CORRESPONDENCE SCHOOLS

Box 992, SCRANTON, PA.

Explain, without further obligation on my part, how I can qualify for the position before which I mark X.

Electrical Engineer	Civil Service	
Electric Lighting Supt.	Railway Mail Clerk	
Electric Car Running	Bookkeeping	
Electric Wireman	Stenography & Typewriting	
Telephone Expert	Window Trimming	
Architect	Show-Card Writing	
Building Contractor	Lettering & Sign Painting	
Architectural Draftsman	Advertising	
Structural Engineer	Salesman	
Concrete Construction	Commercial Illustrating	
Mechanical Engineer	Industrial Designing	
Mechanical Draftsman	Commercial Law	
Refrigeration Engineer	Teacher	
Civil Engineer	English Branches	
Surveyor	Good English for Every One	
Mine Superintendent	Agriculture	
Metal Mining	Poultry Farming	
Locomotive Fireman & Eng.	Plumbing & Steam Fitting	
Stationary Engineer	Sheet-Metal Worker	
Textile Manufacturing	Navigation	Spanish
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Street and No._____

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PLEASE KNOCK,
BELL OUT OF ORDER

The chances are that the bell is O.K., but you are simply having BATTERY TROUBLE—AGAIN!

A Viking Bell Ringer

installed in place of your batteries will do away with your bell troubles for ALL TIME.

IT LASTS FOREVER.—No moving parts inside to wear out. Ask your dealer about it.

GET A VIKING TOY TRANSFORMER

for your boy—useful and instructive. Full information on request. ADDRESS DEPT. C.

Viking Electric Company, Inc.

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Flashlights, Batteries
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Complete with Tungsten Lamp and Battery . . $1.50
AT YOUR DEALERS

Interstate Electric Novelty Co.

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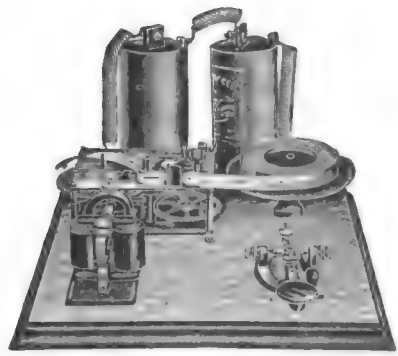
San Francisco
111 New Montgomery St.

This instrument is an outcome of the "National" Automatic Telegraph Transmitter that has been used for a large number of years in teaching students to become operators at home. The sounder has been replaced by a special high pitch buzzer, and a telephone receiver with headband is included with the outfit. The same arrangement of sending the messages is employed, namely, a paper ribbon with perforations, corresponding to dots and dashes, is run past a pivoted lever which moves in accordance with the perforations and opens and closes a circuit through suitable contact points. The clock work mechanism for moving the tape can be adjusted to any speed and the tone of the buzzer can be varied to suit requirements.



AUTOMATIC TELEGRAPH TRANSMITTER

The paper records for the automatic wireless transmitter are quite complete, beginning with the first reel for sending single letters and ending with the last reel containing regular wireless messages. The striking feature of the record is that the characters are not exactly accurate, but have been made by a skilled wireless operator sending in the conventional manner. Thus, the student becomes accustomed to signals just as they are usually transmitted and not to perfect, machine-made records. This feature is a very commendable one.

For full particulars regarding this instrument as well as the various courses in telegraphy offered by the institute, correspondence should be addressed to Dodge's Telegraph, Railway and Wireless Institute, 7th street, Valparaiso, Ind.

COLLEGE RADIO CLUB

The College Radio Club announces the result of its election of officers for the new year, as follows: Charles E. Barr, president; William E. Lambe, secretary, and John T. Shea, treasurer.

The club now numbers twenty enthusiastic members, all students of Christian Brothers College of Memphis, Tenn., where a course in "Radio Telegraphy" has recently been added to the curriculum.

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We teach you Electricity by giving you the actual work to do.

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Our course is an engineering course simplified, yet containing all the elements necessary to the student's success. It eliminates the frills and spectacular demonstrations that serve to amuse but do not instruct. It aims to make the student a working power rather than a store-house of theory which he cannot apply.

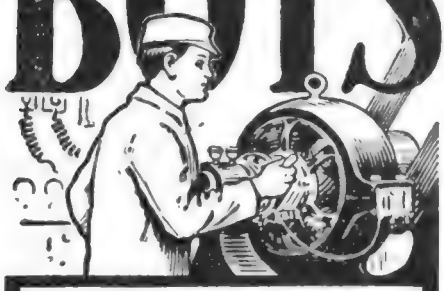
From the day of entrance to the day of graduation a student in our school is an individual, not a member of a class, of a section or division. He enters when he is ready to start and he stays in the school until he is actually qualified to hold a position in any of the many lines of the electrical profession.

Visit our school, if possible, and see our students at work or write for free booklet describing our course and system of instruction.

The New York Electrical School

26 W. 17th Street
New York City

BOYS



Big Money in Electricity

The electrical field affords a wonderful opportunity to boys with a liking for electrical work. The salaries paid are large—promotion rapid, and, best of all, the profession is not overcrowded.

The International Correspondence Schools of Scranton can make *you* an expert in the line of electrical work you like best. Hundreds of boys have already won success through I. C. S. help. *You* can do the same. Everything is made so clear that you can learn in your spare time, regardless of where you live or what you do. No books to buy. See your parents about it—they want you to succeed.

There's big money in electricity. Get after it by marking and mailing the attached coupon *to-day*. Finding out costs you nothing.

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 992-B, SCRANTON, PA.
Explain, without further obligation on my part, how I can qualify for the position before which I mark X.

Automobile Running	Civil Service
Mine Superintendent	Architect
Mine Foreman	Chemist
Plumbing, Steam Fitting	Languages
Concrete Construction	Commercial English
Civil Engineer	Building Contractor
Textile Manufacturing	Industrial Designing
Stationary Engineer	Commercial Illustrating
Telephone Expert	Window Trimming
Mechan. Engineer	Show Card Writing
Mechanical Draftsman	Advertising Man
Architectural Draftsman	Stenographer
Electrical Engineer	Bookkeeper
Elec. Lighting Supt.	Poultry Farming

Name_____

Present Occupation_____

Street and No._____

City_____ State_____

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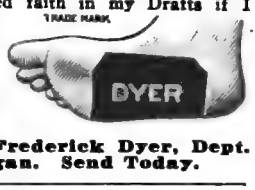
My New Drafts are Relieving Thousands in Every Stage of this Cruel Disease without Medicine

Send Postal for Dollar Trial FREE

To everyone suffering with Rheumatism, I make this unlimited offer: Send me your address and I'll send you by return mail a Regular Dollar Pair of my New Foot Drafts to **try free**—fresh from my laboratory and ready to begin their soothing help the minute you put them on. They are working wonders in every stage of Rheumatism, whether **Chronic, Acute, Muscular, Sciatic, Lumbago, Gout,** or other form—no matter where located or how severe.

Frederick Dyer

Letters are coming on every mail, from all over the world, telling of cures by my Drafts in the most difficult cases, even after 30 and 40 years' suffering and after the most expensive treatments had failed. No matter what your age or how many other attempts have failed. I want you to **Try My Drafts Free** without a cent in advance. Then, **afterwards,** if you feel that you have at last found the long sought cure, you can send me One Dollar. If not, simply write me so, and they cost you nothing. **I take your word—I leave it all to you.** You can see that I couldn't have such unbounded faith in my Drafts if I did not feel positive that they are more prompt and sure than any other remedy known. Don't hesitate. Remember I'm taking all the risk of failure, not you. My valuable illustrated book on Rheumatism comes Free with the Trial Drafts. Address **Frederick Dyer, Dept. 282, Jackson, Michigan. Send Today.**



THIS OXYGENATOR BOOKLET

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Every sick man and woman in the land should read this great booklet. Costs nothing to get it. It points the way to honest health, true wealth, real happiness. The more you have suffered, the severer your ailment, the more you have "doctored"—the more you need to read this wonderful story about Oxygenator, the most marvelous discovery of the age. No matter what the age, it is to your advantage to read this booklet from cover to cover—whether you have stomach or bowel trouble, rheumatism, liver, kidney or bladder disorder, catarrh, lung or bronchial trouble, blood or nervous disease, ailment or weakness peculiar to men or women, scrofula, Bright's disease, blood poison, appendicitis, or what. It shows how thousands have been cured by this wonderful discovery without medicine or knife, and after all else failed.

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Big Entertainer 320 Jokes and Riddles, 153 Parlor Games and Magic, 15 Tricks with Cards, 73 Toasts, 7 Comic Recitations, 3 Monologues, 22 Funny Readings. Also Checkers, Chess, Dominoes, Fox and Geese, 9 Men Morris. All 10c. postpaid.

J. C. DORN, 709 So. Dearborn Street, Dept 37 Chicago, Ill.

When writing, please mention "M. E. and M."

A SYSTEM OF COMPRESSED AIR

(*Continued from page* 160)

In conclusion, a note is appended in which, the method of calculating in connection with these compressors is given.

NOTE: 1. Method for determining the available horsepower of a head of water.

Horsepower of Head = Height of Head multiplied by Quantity of water passing over per second multiplied by 62.5 (the result here is in ft. lbs.) divided by 550.

E. g.: A head of water 69 ft. high with a volume of 7 c. ft. per second will have a horsepower of:—

$$\frac{69 \times 7 \times 62.5}{550} = 55 \text{ H.P.}$$

2. Method for finding the quantity of water required to develop any desired horsepower of air from a hydraulic compressor.

In using this method it is usual to regard the compressor efficiency as 75 per cent. or ¾ of the horsepower developed by the head of water. Sometimes a specific efficiency of the compressor is stipulated in the contract, in which case these remarks do not apply.

$$\text{Quantity of Water} = \frac{4}{3} \times \text{desired H.P. of air} \times 550 \div \text{ht. of Hd. of Water} \div 62.5.$$

Suppose, for instance, it is required to calculate what volume of water in a head of 71 feet will develop 5,100 H.P. in the air delivered; we proceed thus:

$$\text{Quantity} = \frac{4}{3} \times \frac{5100}{1} \times \frac{550}{1} \times \frac{1}{71} \times \frac{2}{125}$$

$$= \frac{299200}{355} \text{ c. feet per sec.}$$

$$= 843 \text{ c. feet per second.}$$

In the above calculation multiplying by 550 reduces the H.P. of the water to foot lbs. of energy. Dividing this result by the height of the head of water obtains for us the weight of water, whence, knowing the weight of one c. ft. of water to be 62.5 lbs. the volume per second is simply deduced.

MORRISANIA RADIO CLUB

On November 4, the Morrisania Radio Club was organized at 937 College avenue, Bronx, N. Y., and the following officers were elected: A. Frey, president; R. Hagen, vice-president; L. Folkes, treasurer, and V. Fritch, secretary. All wireless amateurs in New York City are cordially invited to join, as the purpose of this organization is to bring the amateurs into closer touch. All communications should be addressed to the secretary.

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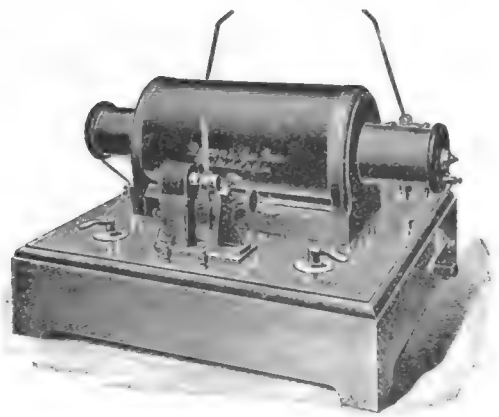
HIGH FREQUENCY CURRENT APPARATUS

(*Continued from page* 164)

45 inches long or more, are wax impregnated, the wax being applied while the coil is in a vacuum so that all air bubbles are removed from the mass. These air bubbles are the cause of many breakdowns in large coils. For a 12-inch spark coil it is not necessary to have the secondary impregnated in a vacuum, but if the maker has the facilities for producing a vacuum, the insulation and life of the coil may be much enhanced. To impregnate the secondary in a vacuum, the secondary when completely wound, is placed in an air-tight metal cylinder having sufficient strength to



withstand the heavy strain to be imposed upon it when exhaustion takes place. When exhausted to the maximum degree attainable, the hot wax is admitted to the chamber where it will thoroughly permeate every part of the winding. After it has become cold, it is removed from the cylinder. Paraffine wax of good quality will be satisfactory for all purposes here, but beeswax is a much better insulator, although it costs about three to four times as much as paraffine. In using paraffine wax, care must be taken that it never reaches the boiling point or not over 100 degrees Fahrenheit, as it then loses to a considerable degree its insulating properties. The best way to heat it, is to have a melting pan or vessel set within another larger one con-

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taining water, similar to an oatmeal cooker. About the simplest and most efficient method of impregnating the secondary wire is to immerse the spools of new wire in melted paraffine wax, until all air bubbles cease to rise from them, indicating that the wire is thoroughly permeated with the wax.

The secondary for this coil is to be divided into 90 pies, each pie ⅛ inch thick. To wind the pies or sections, a winding machine must be fashioned, a sketch of a simple one being given in Fig. 2. The centre, or core, of fibre, should be ¼ inch larger in diameter than the outside diameter of the insulating tube over the primary coil and have its edge slightly tapered so that it will readily release itself from the pie when the latter is wound. The sides of the form may be of hard wood or brass. For use in winding transformer sections where the turns on the pie must be counted, a bicycle cyclometer can be attached so as to register one point for every revolution of the form. If not of the resetting type, simply subtract the reading at starting from that observed at finishing and the answer will be the number of turns on the pie. The distribution of the total amount of wire on the secondary among the 90 pies, is most easily accomplished by dividing the gross weight of wire by 90, which gives 2.13 or 2⅛ ounces of wire to each pie for the No. 36 winding and 2⅔ ounces per pie for the No. 34 winding.

When the wire on the spools has been all prepared as described above by immersing in hot wax, the arrangement illustrated in Fig. 3, will be found quite suitable for winding the pies. A bunsen gas flame is placed upon a table, about two feet below the wax impregnated spool of wire; the rising heat keeping the wax soft while it is wound on the form. Use no more heat than that required to keep the wax soft and hot. When the requisite amount of wire is on the pie winder, remove the lock nuts from the shaft, and with the aid of a thin flat knife inserted between the wire and the side of the form, loosen the pie which will hold its shape nicely and the tapered centre block will come out easily. If the centre block does not come out easily, place a turn of thin paper around it before starting to wind the next pie.

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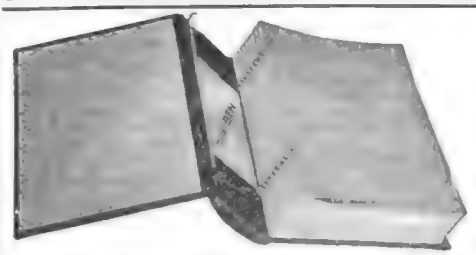

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they must be assembled over the insulating tube. All the pies should be wound in the same direction and every other one reversed in its position when assembling, after the manner depicted in Fig. 4. The object of doing this is to prevent the crossing over of the leads from one section by those of another, causing a pie to be short-circuited sooner than if the method here shown is followed. By reversing every other pie it is possible to connect first two inside leads and then two outside leads together, the direction of the current always being in the same direction. Three well paraffined paper discs, each about 6 mils* thick and 1 inch greater in diameter than the pies, should be placed between every pie and its neighbor in assembling. A view of the cross-section of the secondary is shown in Fig. 4a.

To keep the secondary winding as compact as possible the special heating copper or iron shown in Fig. 5 is very useful, its diameter being the same as that of the pies. As each pie and its paper discs are set on the tube, the warm iron is pressed down over it, causing the secondary to be quite solid when completed, leaving not less than 2½ inches between the end sections and the ends of the tube.

The construction of the interrupter and condenser is covered in the next chapter.

*1 mil = one-thousandth of an inch.

(*To be continued in the March issue*)

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Contributed by *R. Lisle Braught.*

It is interesting to note the numerous churches throughout the United States that are now using electric signs to attract attention.

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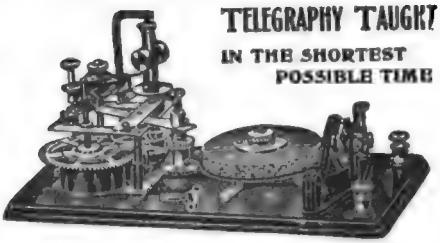

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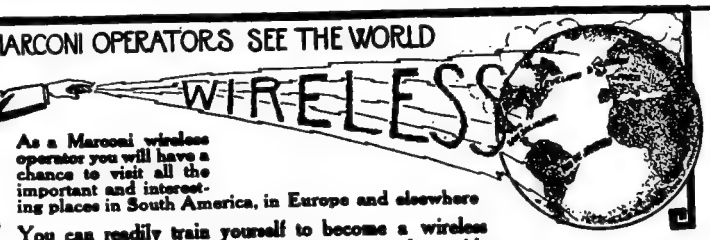

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SELENIUM AND SELENIUM CELLS

(*Continued from page 205*)

electric current actuate the telephone membranes in true accordance to the operator's voice. Speaking, singing and whistling can be distinctly heard in the telephone receivers. The vibrating acetylene flame is at the focus of a concave mirror in order to increase the illumination of the distant selenium cell. The insertion of a small disc of metal, cardboard, etc., between the selenium cell and the flame will instantly stop the transmission. The apparatus will work in diffused daylight as well as in the dark.

THE LICENSED WIRELESS OPERATORS OF WESTERN NEW YORK

The East Buffalo Wireless Club has been reorganized for the season of 1913-14. Not liking the name previously used by the club, a new name has been adopted, and the club is now known as the Licensed Wireless Operators of Western New York.

Meetings are held on the second and fourth Tuesday of every month. Inasmuch as the club has only been organized a short time, the membership is not very large at present, but there are prospects of many more amateurs joining during the winter.

The club will be pleased to communicate with other similar organizations or any individuals interested in wireless telegraphy. All communications should be addressed to A. H. Benzee, secretary-treasurer, 701 Walden avenue, Buffalo, N. Y.

RADIO AMATEURS OF DETROIT

A change has recently been made in the organization of the Radio Amateurs, of Detroit. The present officers are: Arthur A. Smith, president, 721 Hubbard avenue, and Charles O. Apgar, secretary and treasurer, 520 16th street, Detroit. The club is desirous of communicating with other similar organizations, and all communications should be addressed to the secretary.

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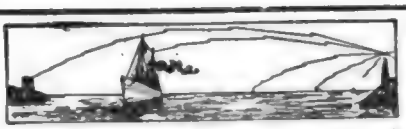

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Wireless Telegraph Contest

The Wireless Station and Laboratory contest is a regular monthly feature. The best photograph submitted each month is awarded a first prize of Three Dollars; second best, Two Dollars; third best, One Dollar.

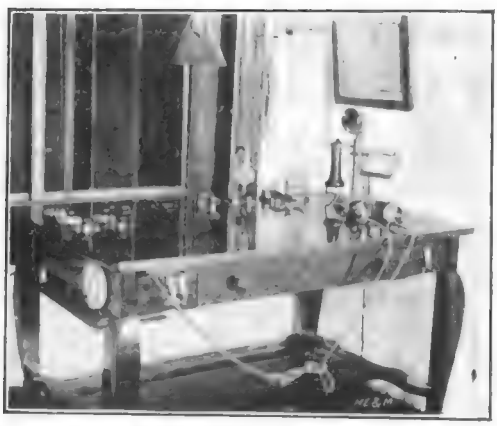
The description of a station should not exceed 250 words. Write on one side of the paper only, using as many separate sheets as are necessary. Descriptions should be written in ink—not pencil. Typewritten descriptions using double spacing are preferable to any. It is advisable to send two prints of the photograph whenever possible—one toned dark and the other light—in order to permit of choosing the one best adapted for reproduction. Prints should be sharp and distinct.

This competition is open to all, irrespective of whether they are subscribers or not.

FIRST PRIZE

We are submitting a photograph of our receiving station for entry in your wireless contest.

The instruments comprising this set are mounted about a mahogany table, within which most of them are concealed. At the left end of this table may be seen a number of adjusting



STATION OF MESSRS. ECKARD AND MC FEETERS

knobs. The one at the rear corner serves to adjust a loading inductance, the capacity of which is about 10,000 meters. Just in front of this are two switches used for adjusting the primary of a loose coupled tuner. To each of the contacts of one of these switches are connected 10 turns, and to each point of the other, 1 turn, of the primary inductance. This arrangement affords a very fine adjustment. The two knobs further toward the front serve to adjust the coupling and inductance of the loose coupler secondary. To the right of the above switches, and at the rear of the table, are the projecting handles of two Clapp-Eastham variable condensers. Nearby may be seen a perikon detector, and an audion. The pair of trans-Atlantic receivers seen lying on the table have been replaced by three sets of navy type phones since the photograph was taken. The key operates a relay connected to our transmitting apparatus, which is located in another part of the building. The receiving room in which the above instruments are located was especially built for the purpose, and is nearly soundproof. We are more than pleased with the results we are getting from this set, which has cost a great deal, both in time and money.

A great many of our ideas were obtained from *Modern Electrics*, which we have taken for years.—*Lewis J. Eckard and John McFeeters, Philadelphia, Pa.*

SECOND PRIZE

A photograph of our wireless station is herewith submitted.

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A gentleman in the West says: Just received your superb catalog. It is better than a $10.00 text book.

Another patron writes: It is certainly well gotten up, and any one interested in "anything electrical" should have it.

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This catalog will be mailed upon receipt of 6c., stamps or coin, which may be deducted from first $1.00 order. Cost of publication and low prices prohibit distribution to other than those really interested.

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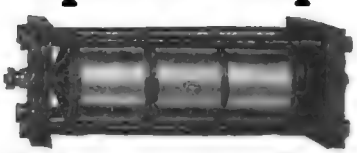

Have you read the article about it in last month's Modern Electrics & Mechanics? We have the exclusive distributing agency for this new invention from which such remarkable results are being obtained. Repeated tests have proven it capable of increasing the efficiency of any ordinary type of wireless transmitter from 50 to 90%. Ask for special descriptive circular.

Dealers Attention—We are prepared to quote liberal terms on this instrument to live dealers. Write us at once and be first in your field.

Our Guarantee is an assurance of perfect satisfaction. Our enormous business has been built up by selling only the best at money saving prices.

The J. J. Duck Company

432-434 St. Clair St. **Toledo, O.**

When writing, please mention "Modern Electrics and Mechanics."

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Brandes' Wireless Receivers

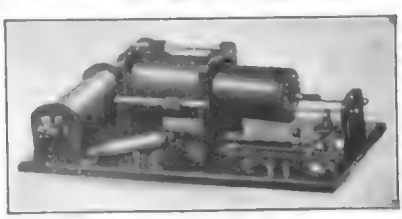
Designed for Long Distance Reading

Our headsets are carefully tested for Long Distance Reading before they leave our factory. They must come up to our standard before we allow them to pass from our hands. Therefore, in buying Brandes', you are assured that you are getting Receivers which "have made good." Send stamp for descriptive matter.

C. BRANDES, Inc.
WIRELESS RECEIVER SPECIALISTS
3 Liberty St., NEW YORK

Pacific Coast—Aylsworth Agencies, 149 New Montgomery St., San Francisco.
Chicago—Winger Elec. & Mfg. Co., 713 So. Dearborn Street.
Australia—G. C. Hamilton, Ltd., 177 Elizabeth St., Sydney, N. S. W.

$10.85 THE TIME SIGNAL RECEIVING SET (good for 2500 miles) $10.85



A large capacity coupler with an eight point secondary and patent sliders. Primary and secondary wound with silk wire. Our 4 point loading coil 7½" long wound with No. 30 silk wire. Good for any wave you are after. Correct capacity fixed condenser. Our Don't Jar Out Detector. Buzzer tester and key. One 365 ohm potentiometer. One 1000 ohm double pole receiver and cord. One nickeled headband. Send stamp for bulletin "G" of other remarkable values. NICHOLS ELECTRIC CO., 35 FRANKFORT ST., N. Y.

When writing, please mention "M. E. and M."

A loose coupler with 2,000 meter range, 3,000 meter triple-slide tuner, which may be used either alone or as a loading coil; ferron, galena, perikon, and silicon detectors; two variable condensers; adjustable condenser; graphite rod potentiometer, and two pairs of Brandes trans-Atlantic receivers.

The sending set consists of a ½-kw. closed core transformer; enclosed rotary spark gap, giving a tone exactly like Cape Cod; adjustable oil immersed glass plate condenser; pancake oscillation transformer; hot wire ammeter, and two keys with heavy silver contacts.

With the above outfit, which is entirely home made with the exception of the receivers and keys, we have received messages from Porto Bello, Panama

STATION OF MESSRS. G. B. AND T. D. RICHARDS.

(NAY), Colon, Panama (NAX), Guantanamo, Cuba (NAW), and all the coast stations as far north as Cape Sable, Nova Scotia (MSB). While using ¼-kw. we have transmitted as far as Wheeling, W. Va., in day time, a distance of 50 miles, and have been heard at Canton, Ohio, 85 miles away, while using ½-kw. of power.

We have worked very hard to bring our station to its present state of perfection, and MODERN ELECTRICS has been of great help to us. No other magazine could possibly take its place in the experimenters' library.

We would like to communicate with any station within 85 miles of Pittsburgh. Our call is BCT or 8CI, and we are generally listening from 7 o'clock until 10 o'clock every night.—*George B. Richards, Jr., and Theodore D. Richards, Pittsburgh, Pa.*

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IMPROVED DETECTOR

ENDORSED BY COMMERCIAL WIRELESS OPERATORS

Triple Adjustment. Mechanically and Electrically Perfect. A great favorite among operators everywhere.

POSTPAID
$2.00

This detector has a genuine hard rubber base—not composition. All the parts are of brass, attractively and durably nickel-plated. Tension at the point of contact can be instantly varied by a simple turn of knurled rubber knob. Post is pivoted and cup is rotatable so as to enable every portion of crystal to be reached. Postpaid, $2.00.

A. H. Grebe & Company

10 VAN WYCK AVE.
RICHMOND HILL, N. Y.

"H-C" RECEIVERS
FOR WIRELESS OPERATORS

Weight only 10½ ounces.

Sensitive to the slightest vibration.

They excel in the essentials.

Every Set is fully guaranteed.

Send for booklet No. 20E3

The Holtzer-Cabot Elec. Co.

CHICAGO, ILL. BROOKLINE, MASS.

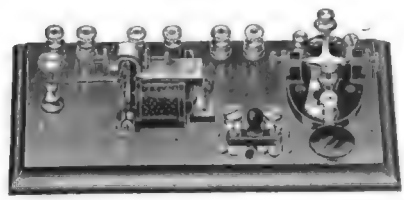
Did You See the

BUZZOPLEX

for Learning Wireless Signals. Testing Crystal Detectors. Regular Wireless Transmitting Key. And for operating regular telegraph line circuits many miles long with one cell of battery.

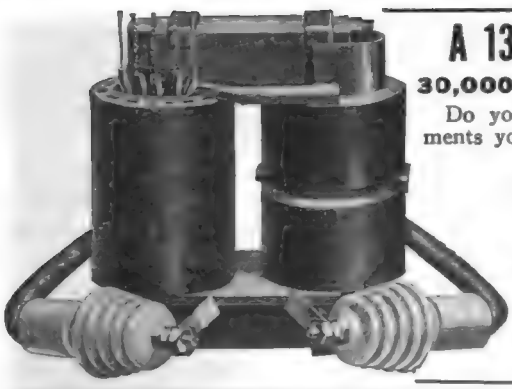
Send for free descriptive circular of the Buzzoplex. Also for our new Manual of Instruction and Wireless Catalogue.

A USEFUL APPARATUS



Price $12.00
Subject to Discount

J. H. BUNNELL & CO., Inc., Electrical Manufacturers
32 Park Place (Broadway Block), New York



A 13200 Volt Transformer for $9.

30,000 TURNS OF WIRE ON THIS TRANSFORMER

Do you realize that to meet the government requirements you *must* use a small condenser?

How will you get full power out of a small condenser?

The answer is, Use **high-voltage** transformers."

In other words, **Packard transformers.** The above transformer is almost a ½ kw., for it can be used with 4 amperes primary. Order today

The Packard Electric Co.

WARREN, OHIO.

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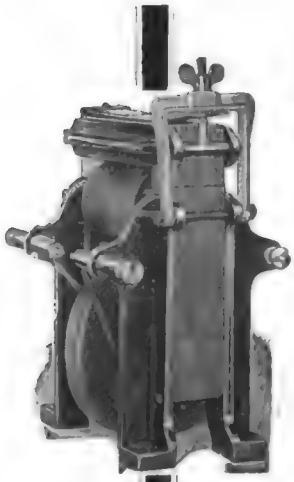

For Better Wireless

The Thordarson Wireless Transformer will improve your apparatus and increase your range. It is built in three standard types, 5,000, 10,000 and 20,000 volts, with special windings to order. Connects direct to A. C. mains — all transformers equipped with flexible impedence.

Write for particulars

THE THORDARSON ELECTRIC MFG. CO.
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Note Sliding Adjustment
Price $2.00

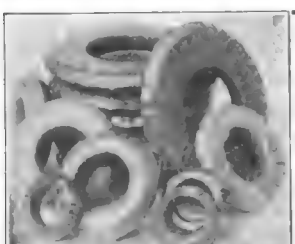
IMPERIAL DETECTOR

The best detector made for amateur use. Is mounted on a polished fibre base. Has the most sensitive adjustment of any detector made.

SUPPLIES

Buy the raw material and make your own instruments. Send for Catalogue K 4.

Imperial Electric & Mfg. Co.
6855 So. Halsted St. CHICAGO, ILL.



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Send 2 cent stamp for our "Secondary Unit" leaflet, also for catalogue of WIRELESS apparatus and supplies.

We are Chicago Agents for "BRANDES" WIRELESS PHONES

WINGER ELECTRIC & MFG. CO., (Not Inc.)
713 So. Dearborn St. Chicago, Ill.
Successors to Dawson & Winger Electric Co.

When writing, please mention "M. E. and M."

THIRD PRIZE

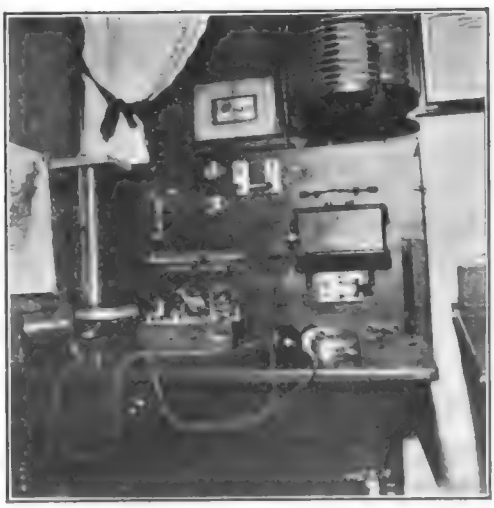
I submit a photograph of my radio station for entry in your "Wireless Telegraph Contest."

The receiving set consists of two 2-slide tuners hooked up in an original way, two variable condensers, Brandes 2,000-ohm receivers, potentiometer, variometer, buzzer test, and galena, perikon, ferron, silicon, and carborundum detectors.

For sending I use a 1½-inch Mesco coil, spark gap, key, helix and condenser.

I haven't broken any sending records, but in receiving I have heard very distinctly as far as Colon, Panama, which is a distance of about 2,500 miles. I hear practically all the Government and commercial stations along the Atlantic Coast.

This work was done on my receiving



WIRELESS STATION OF EDNA SCOTT

aerial, which is made of one No. 20 copper wire, 800 feet long and 75 feet high, while employing the Perikon detector and Brandes 2,000-ohm receivers.

My sending aerial is 100 feet long, 110 feet high, and consists of 4 strands of No. 14 aluminum wire. My call letters are MQ.—*Edna Scott, New York City.*

As a progress of the times, no better example could be found than the installing of electric wiring for lighting the famous Egyptian temple of Rameses II, built over 32 centuries ago.

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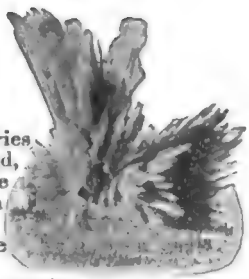
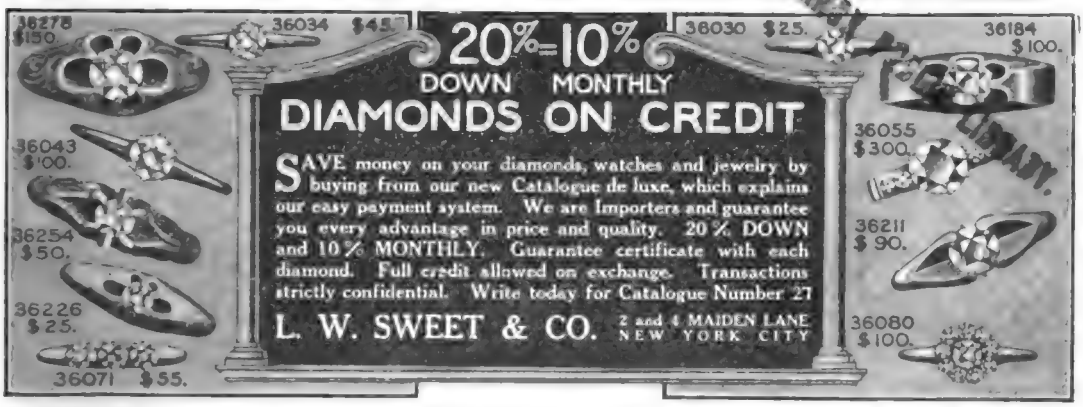
WE TEACH YOU FREE

Our extensive national advertising yields thousands of inquiries from farmers, orchardists, etc., who need blasters to clear land, blast ditches, holes for tree planting, tight subsoils, etc. More than twenty million pounds of agricultural dynamite used in 1913. We refer all inquirers to nearest blaster, supply free advertising matter and help you get the business. We want to start in this independent business, reliable men who have $200 capital for tools, magazine, and running expenses. Write for free booklet No. [illegible] B.



Agricultural Division, Du Pont Powder Company, Wilmington, Del.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SAVE money on your diamonds, watches and jewelry by buying from our new Catalogue de luxe, which explains our easy payment system. We are Importers and guarantee you every advantage in price and quality. 20% DOWN and 10% MONTHLY. Guarantee certificate with each diamond. Full credit allowed on exchange. Transactions strictly confidential. Write today for Catalogue Number 27
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Transmitting Sets
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Transformers
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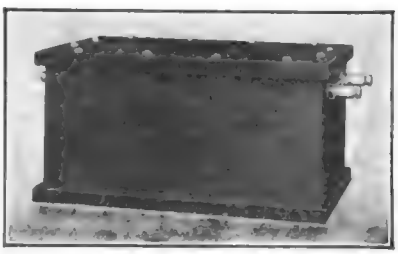
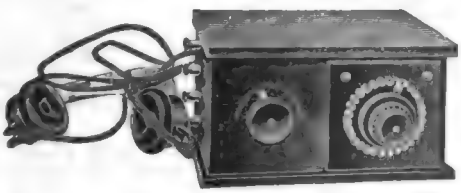
Spark Gaps
Oscillation Transformers
Wave Meters
Tuners **Keys**



THE BLITZEN TRANSFORMER
¼ K.W. $15.00 ½ K.W. $22.00 1 K.W. $36.00



Blitzen Receiving Set, Price, $33.00

If its wireless, we manufacture it in the CLAPP-EASTHAM shops, the CLAPP-EASTHAM way; a little better than the best.

The most complete wireless catalog in America, also a catalog of parts and materials for the construction of apparatus, sent for 4c. stamps.

CLAPP-EASTHAM CO.

143 Main Street, CAMBRIDGE, MASS.

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The Experimenters' Supply House

The best advertisement for the Amco Loose Coupler are the hundreds of well satisfied customers who have declared it is

THE MOST SERVICEABLE AND EFFICIENT LOOSE COUPLER ON THE MARKET

There are more of these instruments in service today than all other loose couplers put together. The design of this instrument is a step forward in the wireless art and has met with the praise of many experts. Bare wire primary. Green silk secondary. Mahogany finished woodwork. PRICE $6.00. Other models $4.00 $8.00 and $12.00.

Complete set of parts, ready to assemble, with blue print....$3.50 With primary and secondary wound, $4.25.

SEND 4c. IN STAMPS FOR THE NEW AMCO CATALOG

We manufacture the largest line of reliable wireless apparatus in the country. Over 100 Wireless Instruments and 200 Parts, with which you can build your own instruments at small cost, are shown in our catalog. Also, Storage Cells, Rectifiers, Transformers, Motors, Dynamos, Steam Engines, Books, Tools, Model Aeroplanes, Electric Bicycle Lamps, Flashlights and Supplies.

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Licensed Agents for the Sale of

PERIKON CRYSTALS

(By the W. S. A. Co.)

For Amateur use only, $1.00 per set

LONG DISTANCE WIRELESS CO. SUPPLIES

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WIRELESS MAP

All operators need it. Wireless encyclopedia in map form. A complete U. S. Map, 28" x 38" showing all Wireless Stations over 1 KW., their calls, power, type and location. Ship routes and calls, time divisions, etc., etc. Amateur data wanted, and quick agents. Postpaid in tube. Send for FREE CIRCULAR. Price only $1.00. Also Mono-Glider booklet $.75. Both $1.50.

B. FRANCIS DASHIELL, Irvington, Baltimore, Md.

EXPERIMENTERS:—When you buy Don't forget that TRACO STANDS FOR GREATEST EFFICIENCY

This Inductive Tuner will greatly increase your Signals. Is equipped with improved slider—Non-Shrinkable Tubes, 10 Point Secondary Switch—will respond to 3200 Meter Waves.

Convert that coarse Pitch into that of a 580 Cyl. set, by installing this Varitone Rotary Gap. Greater Transmitting Range. Hard Rubber Insulation.

Price $7.50 This Month ONLY $6.25

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THE RADIO APPARATUS CO., POTTSTOWN, PENNA.

PRICE This Month $10.00 ONLY $9.00

New High Grade Wireless Apparatus

Boston Variable Condenser, 25 Plates	$2.75
" Mineral Detectors, composition base	1.75
" Combination Mineral Detector, white marble base	4.00
" Double Slide Tuner	2.50
" Helix, fine finish	3.50
" Junior Condenser, 50c; Large Condenser	1.00
" Small Spark Gap, 60c; Air-Cooled Gap.	1.00

Your money back on these goods if not satisfied.

Also Boston Agent for Elec. Imp. Co.

Manhattan Spark Coils Electric Supplies and Flashlights

M. MUELLER

18 Devonshire Street, Boston

YOUR RANGE

depends greatly upon the detector you use. There is only one way to "get" all the signals which are passing over you—

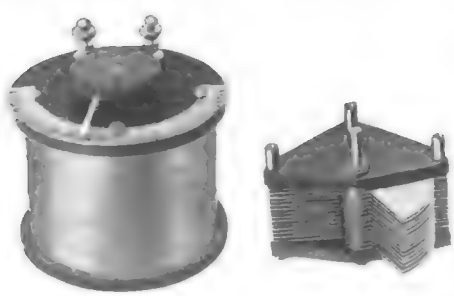
Use Our AUDION DETECTOR

It is the last word in the detector line—extremely sensitive—absolutely permanent in adjustment—not affected by strong signals. Our complete detector set will prove to be the most wonderful instrument you have ever used.

Price, $15.00.
Tested bulbs only $5.00.
Renewal bulbs $3.50 each.
Old bulbs must be returned with order.

Our literature will be sent to you immediately free upon request.

THE WIRELESS MFG. CO. Canton, Ohio



Halcun Junior Variable Condenser

New Halcun Junior Variable Condenser. Capacity nearly .001 MF. 16 stationary, 15 movable aluminum plates. Polished nickel plated brass case. Oil tight.

Price, Express prepaid in the United States $5.00

HALLER CUNNINGHAM ELECTRIC CO., 428 Market St., San Francisco, Calif.

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DANGER OF ANESTHETIC ELIMINATED BY ELECTRICAL DEVICE

(*Continued from page 153*)

blood causing a clot in the windpipe, is done away with by a suction tube inserted in the patient's throat by an attendant. This connects with a bottle in which a vacuum is created by the suction pump, and all blood, saliva and other liquids are immediately drawn off. This feature not only prevents danger of strangulation but enables the operator to work with greater ease and also to check the flow from bleeding vessels.

The time required for an operation is shortened by the use of this device, which alone constitutes a strong recommendation, both on behalf of the surgeon and the subject.

Various improvements have been made in this apparatus since the first model was developed and used; the principal advantages of the present device being an absence of noise from the pump and the adoption of an encased motor to prevent any danger of a spark igniting the ether.

In accordance with the best traditions of his profession, Dr. Kellogg has declined to commercialize his device, and has placed his latest model in a Los Angeles hospital for the use of other surgeons. It has been used in about a hundred operations with complete success and its adoption elsewhere will probably revolutionize the administering of anesthetic for operations on the throat and nose.

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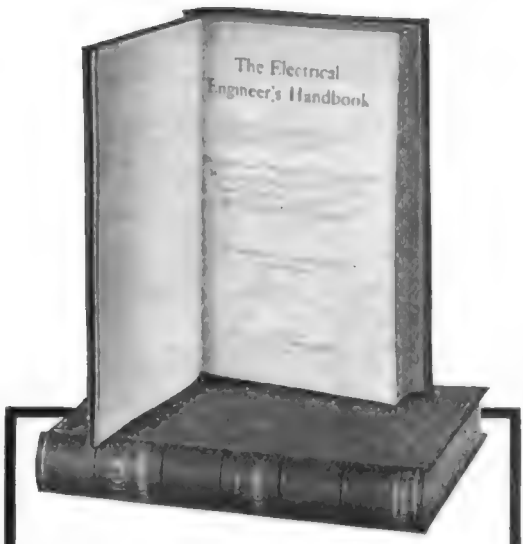
Business Manager.

Sworn to and subscribed before me this 9th day of Oct., 1913.

(SEAL.) H. ADOLPH WINKOPP,
Notary Public, N. Y. C.

(My commission expires March 30th, 1914.)



A Handbook of

Practical Electricity

EVERY man interested in electricity or mechanics should have one of these Electrical Handbooks. It explains in clear and simple terms the fundamental laws of mechanics and electricity, and contains all those rules, formulas, and other information that you've got to have right off the bat—that you haven't time to search for through ordinary textbooks. This Handbook was compiled from the Home Study textbooks of the International Correspondence Schools, and is 3½ × 5½ inches in size, bound in silk cloth, and contains 414 pages and 238 illustrations. Retail price $1.25. A few of the subjects treated are:

Electrical Units; Symbols and Quantities; Metals and Alloys; Magnetism, Dynamos; Motors; Armature Winding; Batteries; Alternating Current Apparatus; Alternators; Transformers; Wattmeters; Transmission; Electric Lamps; Wiring; Electric Heating and Welding; Electromagnets; Controllers; Car Wiring; Etc.

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I enclose 50 cents for which please send me one copy of the $1.25 I.C.S. Electrical Engineer's Handbook.

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When writing, please mention "M. E. and M."

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Questions and Answers

Questions and queries pertaining to electrical and mechanical subjects and of general interest to all readers, will be answered in this department. Name and full address of the sender should accompany all inquiries. Questions that are not deemed by the editor to be of general interest, will not be published and no answers will be given by mail.

THREE PHASE POWER.—TYPE OF TRANSFORMER.

(9) Theodore A. Smith, New York, writes:

Q. 1.—I have in my house 110 volt, 60 cycle, three phase current and I would like to connect in a transformer so as to get a low voltage single phase supply. I am afraid that if I connect it across any two wires that the system will become unbalanced and the transformer will not work as well. The transformer is only a small one, having about 50 watts output.

A. 1.—The only way for you to do is to connect the transformer across any two wires. This will give the same effect as placing it on a single phase circuit and the efficiency of the transformer would be unchanged. The circuit will be unbalanced by loading only one phase, but such a small load as this will not be of any consequence. The motor or whatever the three phase is used for, is probably not nearly as well balanced as to have any harmful effect produced by such a small load.

Q. 2.—I have been told that if the system is unbalanced and of course has different values of current flowing in each wire that I will have to pay for the sum of all of the currents. This would mean that if the transformer was the only load, I would have to pay for twice the current used. Is this correct?

A. 2.—There is often a great misconception in regard to paying for three phase power. If your power is metered by means of a polyphase wattmeter you will pay for the exact amount of power used regardless of whether it comes over two wires or over all three. For convenience consider only unity power factor. If you have only two wires your power would be the product of the voltage between those wires and the current flowing in one wire. The current in the other wire would be the same but opposite in direction. When you load just two wires in the three phase system the same thing is true. Your power is the product of the current in the phase by the phase voltage. Thus you will pay for the same amount of power whether it comes from a single phase supply or from one phase of a polyphase supply. When you are using all three phases with unbalanced loads your wattmeter will record the power supplied in each just as true as if you had three wattmeters on three single phase lines. There is no harm in having an unbalanced system if the unbalancing does not overload any part of the circuit. On long lines it is necessary to consider regulation if the system to be operated is very badly out of balance.

Q. 3.—Which would be the better for general laboratory work, a high tension open core or a high tension closed core transformer?

A. 3.—The closed core will be the most efficient and will have the most rugged design.

GROUND FOR WIRELESS SUPPLY LINE

(10) William E. Finley, California, asks:

Q. 1.—I wish to put a new fuse block on the panel board in the basement to supply a line to go to my wireless

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MURDOCK APPARATUS
CONSISTENTLY AND PERMANENTLY GOOD

Receivers No. 50

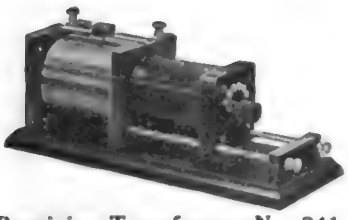
No more sensitive or more serviceable head receivers may be obtained anywhere for all-round work, over any distances, long or short. The sets priced below are guaranteed to equal in sensitiveness any wireless receivers on the market at double the prices.

2000 ohm double set..... $7.50
3000 " " " 8.50

Receivers No. 30L.

A low priced high resistance equipment, satisfying in sensitive operation the most exacting requirements and easily surpassing in service efficiency any similarly priced competitive makes. An excellent equipment for experimenters who desire the best value for limited expenditure.

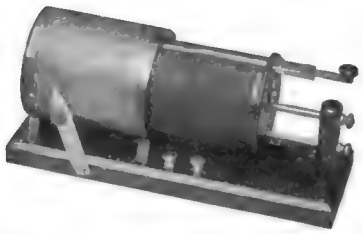
2000 ohm double set..... $5.00



Receiving Transformer No. 341.

Easily and deservedly the most popular receiving transformer ever offered for experimental use. It works with the precision of the most expensive professional instrument: its appearance distinguishes it from its many counterfeit imitations; and its positive efficiency guarantees satisfactory selectivity in every tuning operation.

Price $15.00



Receiving Transformer No. 343.

A moderately priced tuning transformer, the same in principal electrical components as our No. 341, differing mainly in minor materials. Capable of accurate, selective tuning, efficient in every way, it is unquestionably the best low priced receiving transformer available for experimental use.

Price $8.00

Every amateur interested in serviceable, efficient, and reliable apparatus ought to have a copy of our Catalog No. 12, for his better knowledge of the GOOD apparatus which is obtainable at FAIR prices. Get YOUR request for a copy off TODAY.

WM. J. MURDOCK CO.
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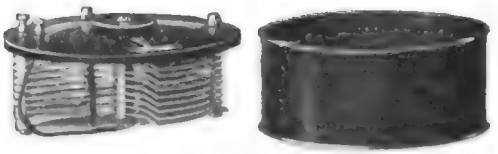

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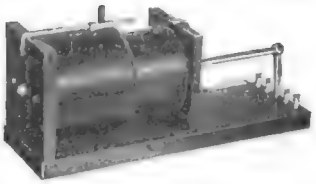

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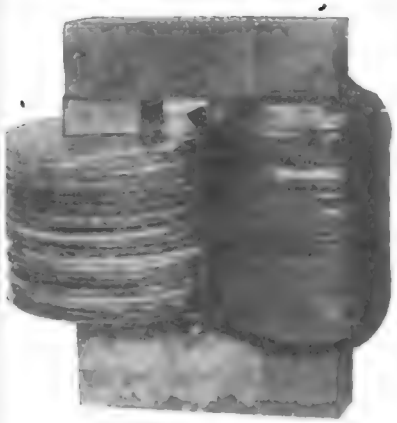

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transmitting set. The supply is 110 volts alternating current. Will I have to ground this line? If so, where?

A. 2.—A new set of regulations of the Fire Underwriters requires that new installations for wireless telegraph transmitting sets must be in approved metal conduit. This conduit must be grounded by a wire not smaller than a No. 8 B. & S. to the water pipe on the street side of the cut-off. In addition to this the line must be protected by some approved form of protective device such as a grounded carbon rod or a condenser and spark gap. As the rulings for this type of installation are becoming very strict you had best see your local wire inspector before making the installation. In any case you will be obliged to have his approval of the installation when completed.

MOTOR SPEED

(11) Francis Hammerle, Mass., asks:

Q. 1.—Why is it that when I connect a resistance coil across the field of a shunt motor that the motor speeds up?

A. 1.—If the motor speeds up it is certain that the size of the resistance coil is such that its resistance is low in comparison to that of the motor field, or else the available amount of current for the motor field supply is small. The coil causes part of the current which was originally going through the motor field to go through the coil and thus weakens the field, or the current taken by the coil is so great that the drop in the line becomes very large and there is not sufficient potential at the terminals of the motor field to permit the original current to flow. When the field of a motor is weakened the motor must speed up. The equation for the induced voltage in the motor armature is E=FNK, where E is the induced voltage, F the field strength, N the revolutions per minute, and K a constant taking into account the type of motor and the units used. Thus, if E is to remain constant and the field F is decreased the only other variable N must be increased. Thus, when the field of a motor is decreased the motor speeds up. This practice of placing a shunt resistance on the field

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of the motor is a very foolish thing to do. It is merely consuming power and doing no good. If you want to regulate the speed put the resistance in series with the field and not in parallel with the field. Increasing the series resistance will increase the speed of the motor.

WSL PRESS SERVICE

(12) N. Fargo, North Dakota, asks:

Q. 1.—Where does WSL send? I never hear any one answer this station.

Q. 1.—WSL sends press news out to ships fitted with Debeg apparatus. The news is similar to that sent out by the Marconi station at Cape Cod. The news is just sent broadcast. Because of the fact that this news is preceded by a statement that it is for Debeg ships only, other ship or land stations cannot publish a copy of this news. The Marconi news service is likewise protected. Amateurs would do well to keep this fact carefully in mind because under the act of December 13, 1913, it is just as great an offense to publish the news copied from either of these stations as it is to publish an important Government dispatch.

LIGHTNING PROTECTION

(13) Leo Lafrie, New York, asks:

Q. 1.—If I have a home-made switch on a marble base, the dimensions of the switch being essentially those of a 500 volt, 100 ampere, D. P., D. T. switch, can I use it in connection with my wireless set for lightning protection?

A. 1.—If the mechanical construction of the switch is good and the holes are drilled as required in the Fire Underwriters specifications there will be no objection to using the switch. Better be sure that the switch is in complete accordance with ALL of the requirements before installing it so as not to leave any loop holes by which the insurance company can avoid paying your insurance in case your house was damaged by lightning and fire followed. Get your local inspector to approve the switch.

Q. 2.—Is it necessary to have No. 4 copper wire go from the aerial to the switch and from there to the ground?

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E. I. Co. 1914 NEWS

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8487

Our new loading coil has a wave length of approximately 5000 meetrs. If placed in series with either a tuning coil or a loose coupler it is possible to catch time signals from the Arlington Government station using 2500 meters wave length. The use of our loading coil enables one to receive messages from almost any station, no matter what its wave length, up to 5000 meters.

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Size is 4" in diameter and 1½" in height. The diameter of the hard rubber thumb handle is 1". WE GUARANTEE SATISFACTION. No. 8487 Electro Loading Coil, as described. Price..... **$2.50**

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(Improved Type)

810

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Machine is entirely enclosed, practically dustproof, a radical departure in dynamo building. Shunt Wound.

Pulley, 2 inches diameter, V-grooved for round belt.

Size over all is 7x4x4 inches. Weight is 8 lbs. net.

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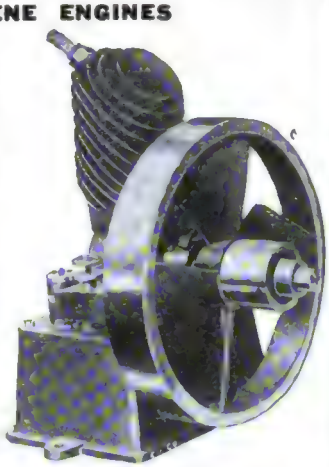

4600 ¼ H.P.

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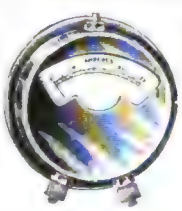

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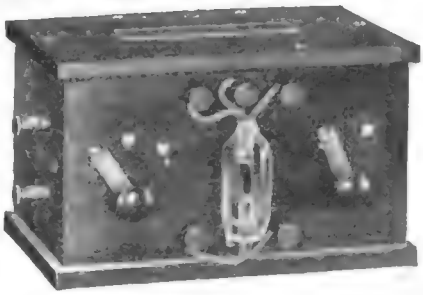

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A. 2.—Yes, it is essential that No. 4 wire be used all the way from the aerial to the ground.

Q. 3.—Must I use No. 4 wire or can I make a cable of several strands of No. 18? In the latter case how many strands must I have in the cable to replace the No. 4?

A. 3.—It is perfectly allowable to replace the single No. 4 by a cable of the same cross-section, in fact it is preferable. If you use No. 18 to make up the cable you will have to use 26 strands.

THERMOPILES

(14) M. Wilkins, Oklahoma, asks:

Q. 1.—What is the nature of the thermo-electric or heat battery in regard to its lasting qualities and practical use when heated by the flame of a bunsen burner?

A. 1.—The thermopile battery will last almost indefinitely. However, it is not considered a very practical form of current generator and for this reason is but little used outside of demonstrating the generation of electricity by means of heating the junction of two dissimilar metals. The drawback of the thermopile is that it requires a considerable amount of heat and in proportion generates but little current. It is advisable to employ chemical cells in preference to the thermopile unless a considerable volume of heat is available at low cost.

SPARK COIL ON ALTERNATING CURRENT

(15) Omer Cote, Rhode Island, asks:

Q. 1.—Can I operate a five-inch spark coil on 60-cycle alternating current by screwing the vibrator down?

A. 1.—The use of spark coils on alternating current is quite possible but not always satisfactory. The frequency of the alternating current supply may not be the same as that of the vibrator on the direct current supply. If the alternating current frequency is less the spark coil will not work as well as it did on the direct current. This will doubtless be the case. Spark coils are best operated on alternating current when fed by a step down trans-

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former giving the same voltage as was used on the direct current. Many spark coils which ran on 15 volt direct current have been put on the 110 alternating current with the vibrator screwed down and great amazement expressed when the coil went up in smoke as the key was pressed. Be sure that you do not impress too great a voltage on your coil when you place it on the alternating current.

Q. 2.—If the coil were placed on the alternating current supply and the vibrator screwed down will it be necessary to use a condenser on the primary, and where?

A. 2.—No condenser will be necessary. The function of the condenser used on the direct current was to reduce the sparking at the vibrator.

SPARK GAP. TRANSFORMER DESIGN

(16) John M. Murphy, Toronto, Can., asks:

Q. 1.—Would it be possible to use the synchronous rotary gap described in the January, 1913, issue, on alternating current?

A. 1.—Yes.

Q. 2.—Are 25-cycle transformers as efficient as 60-cycle?

A. 2.—For all practical considerations, yes.

Q. 3.—What are the essential differences between 25 and 60 cycle transformers?

A. 3.—In the 25-cycle transformers the volume of the iron is greater than that of the 50-cycle transformers by the ratio of 25 to 60. This is necessary in order to have the number of lines of force cut per second equal in each case. It is impossible from the shape of the magnetization curve to increase the flux density in the iron when changing from 60 to 25 cycles, so that the solution is to increase the size of the core. The size of the core means that the mean length of turn in the winding is to be increased and more wire will be used. This factor is small so that it does not affect the efficiency to any appreciable extent.

WAVELENGTH. RECEIVING INSTRUMENTS

(17) William H. Kibble, New York, asks:

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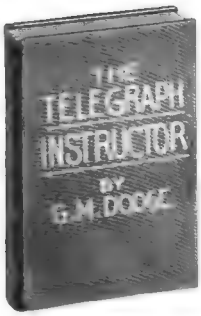

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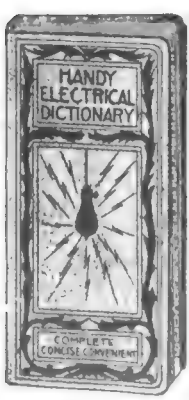

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DICTIONARY

Q. 1.—Please give me a definition of wavelength and explain its meaning?

A. 1.—A wavelength is defined as the distance between the crests of two successive waves. For convenience it is measured in the international standard of length, the meter. In considering electro-magnetic waves it is sufficient to remember that a meter is slightly longer than a yard. Waves are sent out from the aerial in a manner similar to those caused by a disturbance in water. The water waves are much shorter than the electro-magnetic waves but their measurement is just the same. In wireless work the wavelength is determined by the amount of inductance and capacity in the radiating circuit. The greater that either of these quantities is the greater the wavelength. You will find a complete discussion of this subject in any of the books dealing with wireless telegraphy.

Q. 2.—What instruments will be necessary for me to receive the time signals from the Arlington station?

A. 2.—You will need a tuning device of sufficient size to receive 2,500 meter waves. A loose coupler is best suited for this work. You will need a variable condenser across the secondary of this tuner. Besides these you will need the usual detector, phones, and fixed condenser.

RESISTANCE OF RECEIVERS. WIRELESS BOOK.

(18) O. Gauoin, Jr., Rhode Island, asks:

Q. 1.—Is there any way of finding out how many ohms resistance my telephone receivers are?

A. 1.—If you have not the access to some school or other laboratory, or have no standards of resistance of your own there is no practical way of finding out the resistance of your receivers. If you have a resistance box the determining of the resistance by the Wheatstone bridge method is very simple.

Q. 2.—What good book on wireless is there that deals with the construction of the latest types of instruments?

A. 2.—The best book for your needs would probably be the one by Edelman. See advertisement in this issue regarding the sale of this book.

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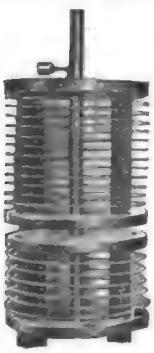

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A BATTERY VIBRATOR

(19) Chas. Coquillard, New York, asks:

Q. 1.—How can I make a good battery vibrator?

A. 1.—A battery vibrator may be easily made from any small battery motor. On the shaft of such a motor mount a small brass cylinder off center, so that more weight is on one side than on the other. When the motor is operated this will cause intense vibration, depending on the size of the weight as well as the speed of the motor. By inserting a variable resistance in series with the motor the speed can be changed to suit requirements. The applicator should be mounted on any part of the motor frame. If desired, a covering of metal can be placed around the motor and the applicator attached to the outside of this covering. A handle will facilitate the use of such a vibrator and can be also attached to the metal covering.

SHOCK FROM REACTION COIL

(20) H. L. Baer, Ohio, writes:

Q. 1.—I have an iron ring made up of laminations with a mean radius of two inches, and a cross-section of four square inches. There is a gap of one inch in the ring. The ring is wound with 330 turns of No. 14 wire. Why is it that when I connect three dry cells to this coil and then break the connection from the coil that I get a very severe shock if holding the two connecting wires? The batteries only have a voltage of about four and without the coil I can never get a shock from them.

A. 1.—When you break the connection you do not get the effect of the four volts but several times that value. When the battery is connected to the coil there is a magnetic field set up by the current. When the current is broken the work that the current did in setting up that field is then given out. A high voltage is induced exactly as a voltage is induced in a generator. You may get several hundred volts if the coil carried a heavy current before the break was made.

Q. 2.—Where could a boy of 18 obtain a position that would pay him enough to pay his board and lodging until he could earn a fair wage and at

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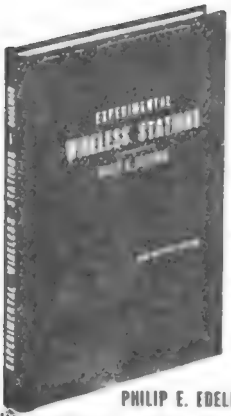

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PATENTED ARTICLES. FREQUENCY

(21) W. B. Byrkit, California, asks:

Q. 1.—I would like to make several articles for my radio station and all of these articles are patented. Will it be possible for me to construct these articles for my own use or will I have to change the design?

A. 1.—The patent law permits you to make any patented article for your own use. You will, however, understand that after you have used these articles a while you would not be permitted to sell them if you so desired. A simple change in design does not very often avoid patent restrictions. Most pieces of apparatus are patented in principle rather than in detail of design. Oftentimes both are covered in separate patents.

Q. 2.—How can a station be tuned to frequency and wavelength at the same time if wavelength depends on the frequency?

A. 2.—When a station is tuned to a given wavelength it will be tuned to the frequency corresponding to that wavelength. Frequency times wavelength equals a constant so that as one is changed the other will have a corresponding change also.

LEAD IN. INDUCTANCE FORMULAE

(22) Charles Noble, Indiana, asks:

Q. 1.—Will 18 strands of No. 30 copper wire be large enough for the lead-in of a wireless telegraph aerial?

A. 1.—As far as the carrying capacity for your set was concerned this would be sufficient, but to comply with the Fire Underwriters' regulations you would have to increase this amount until you had the equivalent of a No. 4. This would require 415 strands of No. 30.

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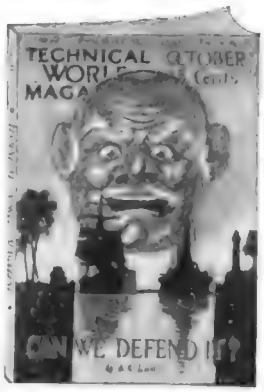

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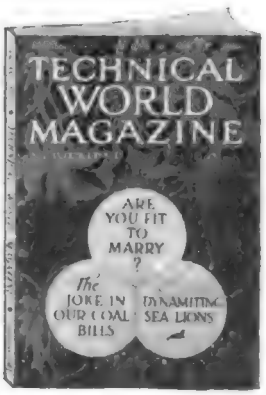

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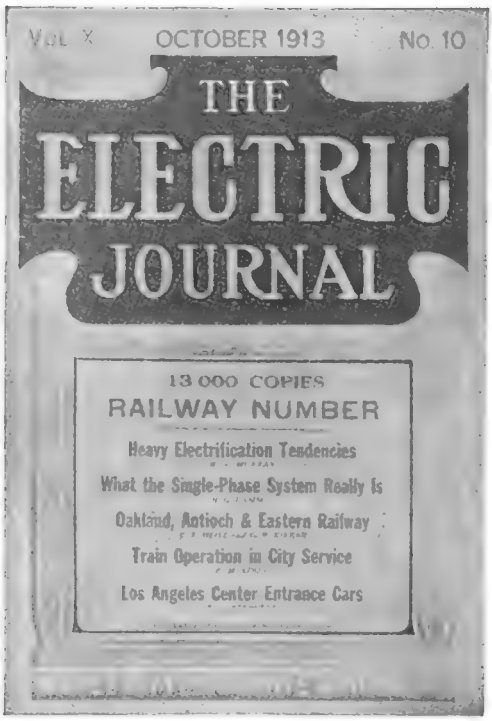

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MODERN INDUSTRIAL AND MILITARY EXPLOSIVES

(*Continued from page 139*)

is, the invention of guns and cannons) belongs to the monk Berthold Schwarz, of Freiburg, Saxony, the date of the latter invention being probably 1313. It is accepted as indisputable that the English used gunpowder in guns at the battle of Crecy, 1346.

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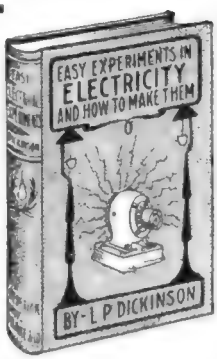

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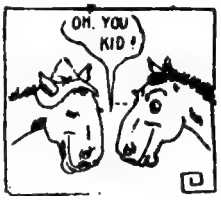

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Nitro-Glycerin:

It was the discovery of nitro-glycerin by Sabrero at Turin, Italy, in 1846, and guncotton by Schoenbein of Basel, Switzerland, a few months previously, which marked a new era in the history of explosives. These two explosives immediately proved that they possessed extraordinary shattering power. They broke up masses of castings and wrought iron, as well as the hardest and most tenacious rocks, on which the old powders could make no impression.

Nitro-glycerin is obtained by acting with a mixture of strong nitric and sulphuric acids on glycerin at the ordinary temperature. When pure, nitro-glycerin congeals, as a rule, at about 40 degrees F., and is not sensitive to blows or detonation. At 212 degrees F. it begins to decompose; at 365 degrees F. it throws off yellow or reddish fumes; and at 423 degrees F. it deflagrates violently. When uncongealed, nitro-glycerin may readily be exploded by concussion; a feature which renders it quite unfit for transportation in that state. It does not detonate when it comes in contact with a flame, and burns with difficulty, like ordinary oil. When heated in a closed space its entire mass explodes as the temperature reaches 257 degrees. Gunpowder, guncotton, or a fulminate exploded in contact with nitro-glycerin produces a tremendous detonation.

Nitro-glycerin is an oily liquid, clear, colorless, having a burning taste, and odorless when at ordinary temperature. It is the most powerful explosive known to man.

An idea of its explosive power may be obtained by comparing it with gunpowder. The heat liberated by its combustion is estimated to be twice as much as that of gunpowder. Hence, while one volume of the latter yields in practice 200 volumes of cold gases that are expanded by heat to 800 volumes, an equal weight of nitro-glycerin yields 1,298 volumes of gas that are expanded to 10,384 volumes, thus giving 13 times the force of gunpowder. But the explosion takes place much

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more suddenly than that of gunpowder, consequently the practical gain in effect is greater than the figures indicate.

Blasting by nitro-glycerin on a large scale was carried out in 1865 in the granite quarries near Stockholm. Five pounds of nitro-glycerin in a borehole 10 feet in depth tore away about 200 cubic yards of granite or about 350 tons. These results were hailed with delight by practical and scientific men, and many experiments and trials were made all over Europe and in the United States. However, the use of this most powerful explosive was fraught with so many dangers, and the cause of so many accidents and catastrophes, that its manufacture and transportation were restricted and even prohibited in several European countries.

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It was Alfred Nobel, the eminent Swedish chemist, who after many experiments with different substances, by chance "tamed" nitro-glycerin by mixing it with an extremely porous infusorial earth, called "kieselguhr." He named the substance thus obtained "dynamite." This was in 1867.

Dynamite:

The present compounds which are in the market under the generic name of dynamite (giant powder is a term loosely used in the United States as a synonym for dynamite), possess all the valuable properties of liquid nitro-glycerin without its dangers, the chief among them being its exemption from liability to spontaneous explosion and to detonation from moderate shocks. The dreadful power of destruction which it conceals lies dormant in the inert sand that absorbs the nitro-glycerin. But a good priming of fulminate of mercury will wake it up, and dynamite explodes with the same violence as pure nitro-glycerin, although not quite so instantaneously. Ignited by a flame and unconfined, it burns

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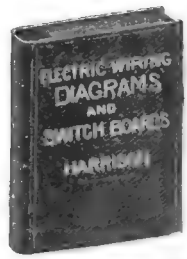

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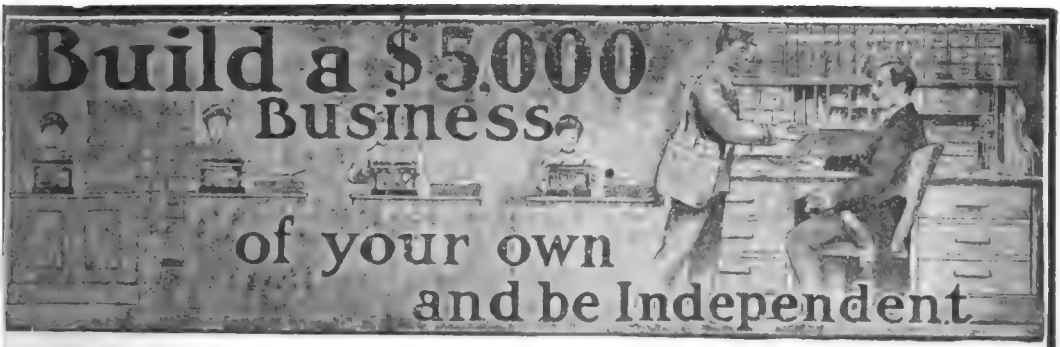

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By modifying the priming we can, at will, use dynamite either as a shattering or relatively slow explosive. By this flexibility which permits of varying its applications, and at the same time by its power and security, dynamite is the most useful of modern explosives.

Dynamite is largely employed in breaking up boulders and the heavier metal-castings, in the construction of tunnels and also in agricultural operations for removing tree stumps and stirring the earth. Under water it loses only about 6 per cent. of its power. Loose tamping, such as sand or water, is found to be amply sufficient and in many instances bore-holes can be dispensed with altogether, the dynamite being simply laid on the surface of the rock to be blasted and covered with sand or clay. However, for quarrying purposes dynamite possesses too great a shattering power and gunpowder is more generally used.

The most vital question which concerns explosives in general is the evolution, or rather concentration, of their power, absolute and relative. The explosive effect or strength of dynamite is made up of three factors: 1, amount of gases formed; 2, temperature of the gases; 3, the reciprocal of time consumed during evolution. With dynamite the time of explosion has been calculated to occupy only a 24,000th part of a second, a fact which explains the violent nature of its action.

Various attempts have been made to further increase the strength of dynamite by replacing its inert base with different explosive materials and an explosive base properly selected may add enormously to the energy developed.

The absorbent material is known as the "base" or "dope," and dynamite may be classified, according to the nature of the base, into: 1, those with an inert base; 2, those with an active base.

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an inert base, dynamite of less than 30 per cent. glycerin will not explode.

The second group comprises those dynamites that are composed of nitro-glycerin and active absorbents, such as sulphur, sodium or potassium nitrate, charcoal, wood pulp, etc. They are sold under such names as: Vulcan, Atlas, Hercules, etc.

"Kieselguhr" dynamite, or dynamite No. 1, is generally made by incorporating three parts of nitro-glycerin with one part of the dry earth or "guhr." This infusorial earth is a silicious limestone composed of small shells, every one offering a cavity in which the nitro-glycerin lodges, and it absorbs from three to four times its weight of nitro-glycerin.

Kieselguhr is calcined, crushed and sifted, and is then ready to absorb the nitro-glycerin. The mixture is thoroughly incorporated by hand by kneading and rubbing through wire sieves, and is then pressed through a cylindrical mould, made up into suitable sized cartridges that are then wrapped in waterproof paper. These sticks or cartridges are generally 8 inches in length and 1½ inches in diameter, usually packed with sawdust in boxes containing 50 lbs. each.

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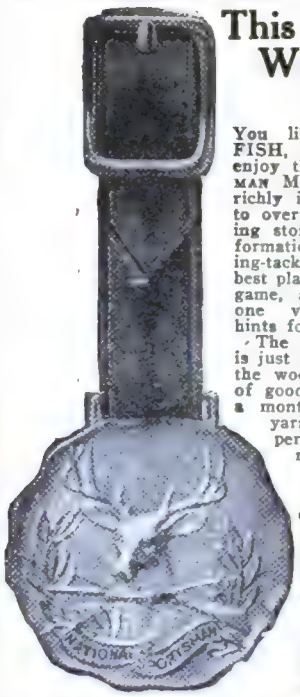

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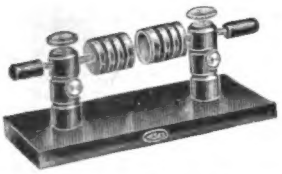

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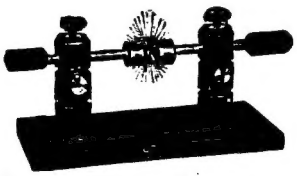

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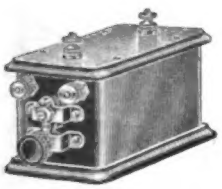

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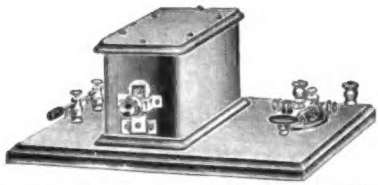

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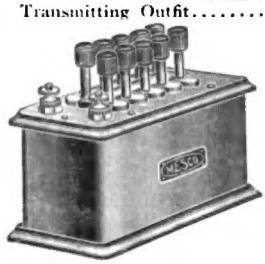

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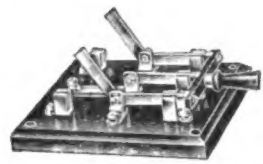

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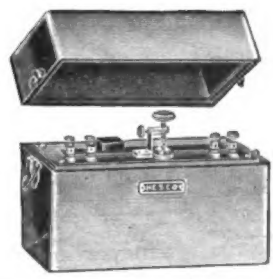

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